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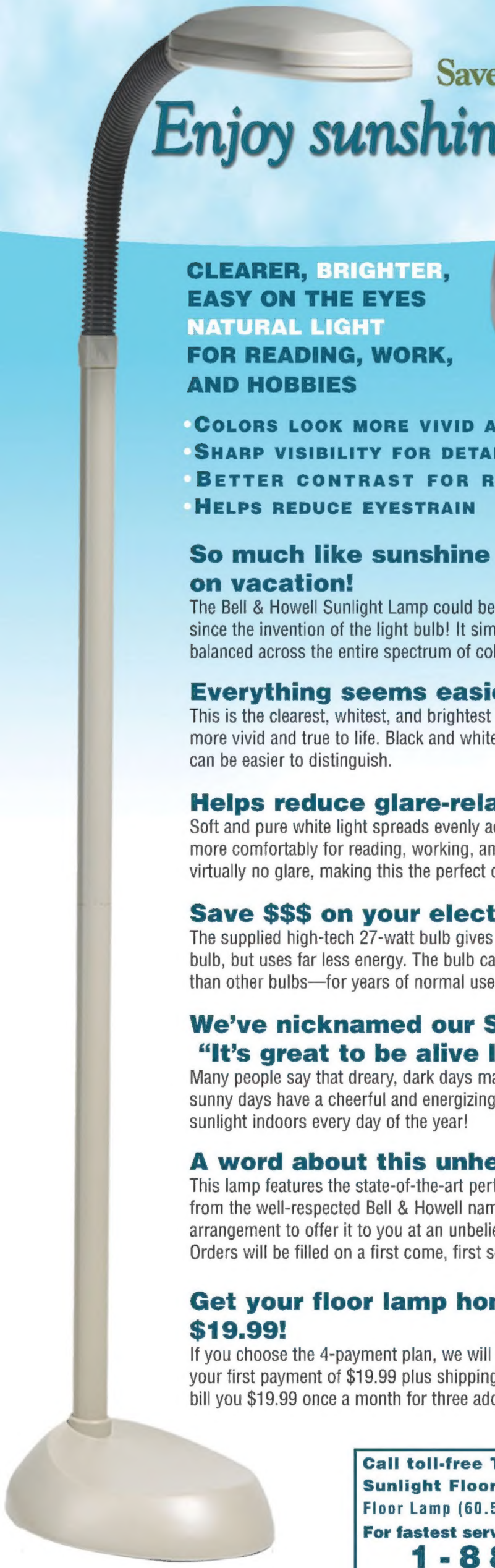

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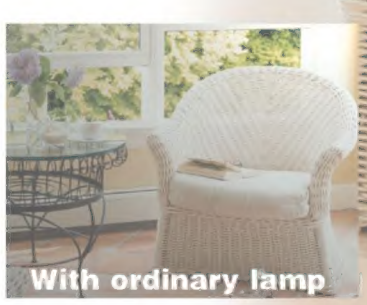

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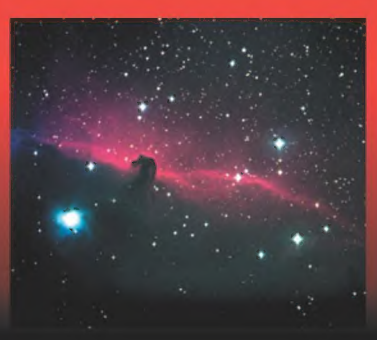

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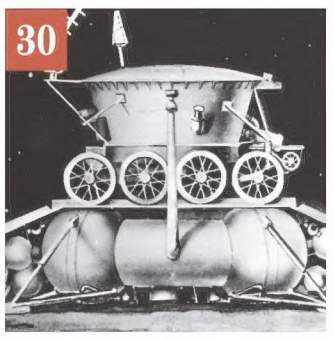
FEATURES



Cover: *After 50 years on ice,* Glacier Girl *flew again on October 26, 2002. Was there ever a better subject for John Dibbs' signature air-to-air closeup than* Glacier Girl *on her day in the sun?*

DEPARTMENTS

We found our best watch in a history book

In 1922, a small watchmaker in Switzerland patented the first automatic watch to display the day, month and date. Only 7 of these magnificent timepieces were ever made and this watch was almost lost to history. Today, they are so rare that one original chronograph watch would probably fetch more than $300,000 at auction.

These watches were among the most stylish of the roaring 20's. And yet no one has attempted to remake this 1922 classic until now. The Stauer watch design that you see here has been painstakingly recreated from the original functions to please even the most discerning owner. The owner of this classic chronograph watch is sure to look distinguished and set apart from the crowd. From the sweeping second hand to the Roman numerals on the unique ivory-colored face, every detail has been carefully reproduced. This Stauer reissue is a limited series, allowing you to wear a watch far more exclusive than many Rolex, Movado, TAG Heuer or Breitling watches.

The watch has a 21-jewel mechanical movement, the kind desired by fine watch collectors. We have updated this movement with kinetic power thus the watch never needs to be manually wound. The watch comes in a beautiful case and comes with both interchangeable black and brown leather bands.

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The Writing on the Walls

Museums inform and educate visitors primarily by presenting exhibitions. The exhibition's content conveys a theme, tells a story, or teaches something, usually with words that appear on walls, panels, and labels. Crafting those words is a challenge for all museums, and that includes the National Air and Space Museum.

The reason exhibition writing presents such a challenge is that we are trying to reach all our visitors, and they run the gamut in age, education, knowledge, and attention span. Many are from other countries, and some speak little English.

Our visitors must contend with numerous exhibitions of almost overwhelming size and scope. They trek through crowded galleries, sometimes with children in tow, and often suffer from "museum fatigue." Most try to cover a lot of territory in a limited time, but if something catches their eye or arouses their curiosity, they stop and read.

The way these issues affect our visitors influences how we write for them. Most people will pick up a magazine article and read it straight through from beginning to end. In writing our exhibition texts, we assume that nobody will read them that way. Each visitor will experience the exhibit differently and, more often than not, follow a path determined by his or her time and interest.

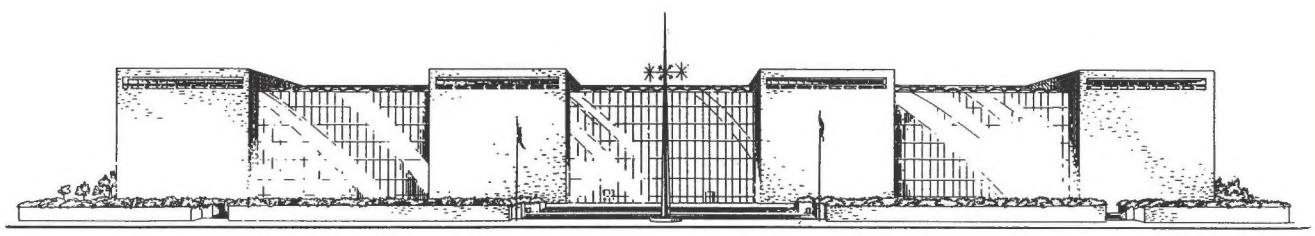
We use many strategies to try to hook visitors into reading a text. We break information up into short bites called labels, which can be read quickly. We strive for writing that is active, concise, and geared toward general interest. We create each label to stand on its own, yet carefully layer all the labels—organize them into a hierarchy—so visitors can make sense of the exhibition as a whole and easily navigate the content.

An exhibition is divided into sections and subsections. Introductory labels, in larger and bolder characters, summarize the theme of each section and enable visitors to follow the exhibition story line. Other labels focus on objects or groups of objects, providing more specific and in-depth information.

The trickiest aspect of exhibit writing is deciding how much information to present. Too many words can clutter an exhibit and discourage people from reading, but too little information can frustrate people with a special interest. A natural tension often exists between curators, who are eager to share their passion for a subject, and other exhibit developers, who worry about information overload and cluttered exhibit designs. To make an exhibit both content-rich and inviting usually involves compromise. There is no formula that works every time.

And not everyone learns best by reading, so we try to offer a range of experiences to broaden an exhibition's appeal and effectiveness: videos, computer interactives, hands-on activities, dioramas, and personal contact with a member of the museum staff. So whether you are a reader or a browser, a doer, a watcher, or a listener, you're bound to find something that intrigues you and inspires you to stop and learn at the National Air and Space Museum.

—J.R. Dailey is the director of the National Air and Space Museum.



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The Story of the British Museum, The Roman Empire and a UFO?

Not long ago, Thomas Cook was examining the strange and mysterious crop circles that had been cut into his farm in Lincolnshire England. While trying to define the origination of these "extraterrestrial" aberrations, he made a discovery that was much more down to Earth. He discovered a hoard of Roman Empire coins in a buried earthenware pot that dated to 270 AD! It was a find of a lifetime. He didn't find any evidence of a UFO but he did find an amazing archaeological site.

According to English antiquities law, these coins were quickly taken into possession by the British Museum where they were studied and cataloged in the archives. The coins received a full "treasure trove inquest" by the museum.

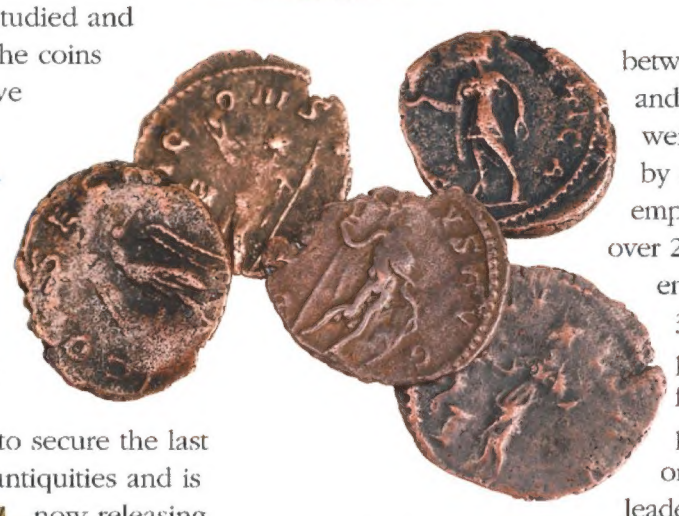
With Museum Approval.

The British Museum has allowed this offering to be made available to collectors since it has carefully studied and catalogued this amazing treasure. The First Federal Mint was fortunate to secure the last 4,993 of these rare Roman antiquities and is now releasing these ancient museum pieces to the public. Each is an original antiquity minted when the Roman Coliseum was still used by gladiators so this is a rare opportunity to own a true piece of ancient history.

Discovered in earthenware pots while investigating a mysterious crop circle, the Roman Antoninianus Coins date back to 270 AD.

How did the Roman coins get to England?

The Roman Empire stretched throughout England. The magnificent Roman ruins in Bath show how vibrant life in the Roman Empire was throughout the British Isles. The years between 270 AD and 285 AD were marked by chaos in the empire with over 20 different emperors and 30 different pretenders fighting for power. Only one of these leaders died a natural death so power in Rome proved quite elusive.



Diocletian Restores Rome's Greatness.

These coins were probably buried during the reign of Emperor Diocletian between 284-305 A.D. This extraordinary Caesar brought back the glory to imperial Rome through his willingness to share power. Diocletian instituted broad economic reforms in an attempt to restore value to the currency. He created a new taxation system to finance the vast armies that held the empire together. Diocletian actually "balanced the budget" for the first time in Rome's history. If only today's leaders were so talented!

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LETTERS

Cult of the Vulcan

When I was a young man, I tried my hand at farming. Our family farm was on Highway 15, near Dorchester, Nebraska, and I farmed with my father-in-law, whose farm was near Cordova, Nebraska. As luck would have it (for me at least), the practice run for strategic bombers was up Highway 15, a westward turn over our family farm, then a further sharper turn over the Cordova farm. Along with B-52s and the occasional B-1, every so often, one of the Vulcan bombers stationed at Offutt Air Force Base in Omaha would screech by ("God Save The Vulcan!," Dec. 2003/Jan. 2004). I got such a kick out of the British copilots waving at me, and I always returned the waves enthusiastically. Since one branch of my family has British ancestry, I envisioned that one of these fine allies was a cousin. And the Vulcan's elegant camouflage spoke of the high English way of doing things.

J.R. Wolfe
York, Nebraska

To see stock footage of a Vulcan in flight, watch the 1965 James Bond classic *Thunderball*. I'm certain any number of Avro engineers chuckled when they saw the Vulcan survive a wheels-up water landing with two H-bombs on board.

Stephen Hashioka
Chicago, Illinois

Your article claims that Vulcan crews could scramble in only four minutes. I simply do not believe this. Just climbing in and hooking up would take longer than that.

Richard Bartholomew
Martinez, California

Editors' reply: We raised the question of scramble time with Contributing Editor and former Vulcan pilot Air Vice Marshal Ron Dick, Royal Air Force (ret.), who responded: "We had four minutes to react, in the worst case from being dead asleep at 2 a.m. to rolling down the runway."

Of the three Vulcans now housed in museums, the one in Nebraska is not, as your article stated, at the SAC Museum at Offutt Air Force Base. That museum no longer exists. The Vulcan from that collection is now in the Strategic Air & Space Museum, located on I-80, halfway between Omaha and Lincoln.

Dick Austin
Bellevue, Nebraska

Making History, Again

Greg Herrick indeed was the visionary and financial backer of the National Air Tour, but "The Magical History Tour" (Aug./Sept. 2003) left out contributors that should be acknowledged: the team led by Dan White at H.O. Aircraft who restored Mr. Herrick's magnificent collection. In order to put these historic machines back into flying condition, the team had to re-create many of the parts and engineering. It is the partnership between Mr. Herrick and Mr. White that allows the country to enjoy this incarnation of America's Golden Age of aviation.

Bernard Weiss
St. Paul, Minnesota

Low-Tech High Fliers

"It's All About Fire, Smoke, and Noise" (Dec. 2003/Jan. 2004) reminded me of my experiences at Red Canyon Range Camp, on what was then the White Sands Proving Ground in New Mexico. Assigned there as an Army radar tech from 1954 to 1957, I constructed several rockets of steel pipe, using expelled solid propellant as fuel. Initially, I lit the rocket by inserting a cigarette in the nozzle. Ignition was instantaneous and a bit unnerving, prompting a change to fulminating-mercury blasting caps, purchased at a hardware store in Carrizozo, New Mexico. (One could do that back then.)

Overall the success rate was high and there were no casualties. But one launch was almost a disaster. At T minus zero, the blasting cap burned through the iron casing, causing the rocket to yaw toward a group of VIPs atop a hill a half-mile away. Luckily, it missed them by a few hundred feet. Thus ended my career in homemade rockets.

MSgt. J.P. Moore
U.S. Air Force (ret.)
Shreveport, Louisiana

Your article perpetuated an old misunderstanding about fireworks. While it is true that class-C consumer fireworks often use black-powder rockets (the "bottle rocket," for example), large fireworks used in professional displays are not powered by rockets. Their construction is similar to that of artillery shells and they are fired from mortars. They do not carry propellant aloft.

Display fireworks do use black powder, lots of it, in both the lifting

"Think back to the days of Lindbergh. That was true courage..."

PHOTO: CAROLYN RUSSO

" Before the War, we would just go flying. No chute, no goggles, you just put a jacket on and went. Today, I so admire the people who fly and explore space, and you can see it all here at this wonderful Museum! "

— LIEUTENANT COLONEL, WILLIAM KONZE, US ARMY (RET.)

In front of the "Spirit of St. Louis." In 1927, with Charles Lindbergh piloting, the Ryan monoplane made the first solo, nonstop flight across the Atlantic Ocean. A gift of Lindbergh to the Museum, it's one of the most historically significant aircraft in the Smithsonian collection.

At age 19, Bill Konze flew in open cockpit single winged planes out of a tiny airport in Morristown, New Jersey with a pilot friend. He spent a long and distinguished career as an officer and civilian with the US Army, beginning as a "ground pounder/gravel agitator" (infantry) in WWII. But he never got over the thrill of being up in the air and his admiration for the pioneers of flight.

Recently, Bill Konze established a charitable gift annuity to benefit the National Air and Space Museum, and he is a proud member of the *Smithsonian Legacy Society*.

Find out how you can include the National Air and Space Museum in your estate plans. Fill out and return the reply form below, or call 202-633-2602. You may also e-mail uniong@nasm.si.edu. Salute the courage of everyone in air and space!

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A&S 03-04

charge (contained in a paper bag at the base of the shell) and the burst charge, which ignites the stars and spreads them across the sky.

But listen to a display carefully and you'll realize that there is no continuous thrust involved—no "whoosh"of rocket motors. The deep "thump" heard when a firework leaves its tube is the lift charge. The sharp "pop" heard when the stars emerge is the burst charge.

Many shells have tubes attached containing a burning material that creates a rocket-like plume as the fireworks ascend, but it's just for show.

Kiff LaBar-Shelton
via e-mail

Airbus: No Stranger to the Spin Debate

I found it interesting that in the Oct./Nov. 2003 issue, an article about spin training ("The Spin Debate") was followed four pages later by an article about Airbus ("The Contender"), yet neither mentioned the wake turbulence incident that caused the crash of an Airbus product, American Airlines flight 587, in late 2001. All air travelers should be concerned by the arguing that followed the crash of that A300—between pilots' union, airline, and manufacturer—over the correct procedures to follow in a wake turbulence encounter in order to avoid spins or rolls. I think all pilots should undergo spin training. The fact that training methods differ, even at the professional level, only further reinforces the need for the Federal Aviation Administration to develop a consistent standard of training.

Adam P. Troidl
Buffalo, New York

America's Short-Lived SST

"The National Air and Space Museum's Steven F. Udvar-Hazy Center" (Dec. 2003/Jan. 2004) states that "Air France and British Airways were the only airlines" to fly Concordes. In the 1970s, Braniff International Airlines also operated a Concorde. I toured it while my Dad worked for Braniff.

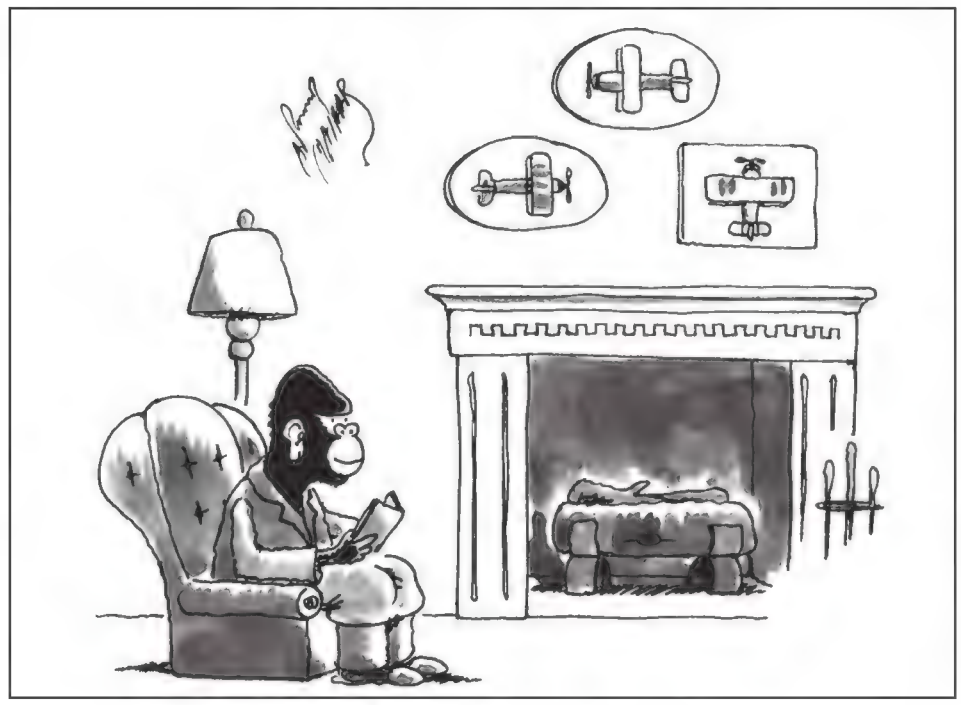
Chris Bissell
Cleveland, Texas

National Air and Space Museum air transportation curator F. Robert van der Linden responds: Air France and British Airways were indeed the only two airlines in the West to own and operate Concordes. They were also the only airlines to purchase Concordes from the manufacturer. However, Braniff International did in fact fly a Concorde, under very special circumstances in order to get around U.S. regulations.

Because no U.S. airline could fly an aircraft registered in another country, Air France and British Airways "sold" five Concordes each to Braniff for that airline to use between Dallas, Texas, and Washington, D.C. The aircraft were re-registered in U.S. markings for the duration of each flight, then "sold" back to British Airways or Air France when the flight continued on to Europe. Braniff supplied the flight crews for the U.S. leg of this interline arrangement, but Air France and British Airways provided backup crews because the aircraft remained insured with Air France and British Airways, and the insurance required those crews. The insurance companies understood the ruse and also understood that Air France and British Airways never gave up actual ownership.

The service began in January 1979 and soon proved unsuccessful. Over land, Concordes were allowed to fly only at subsonic speeds, and the Dallas-Washington leg was usually 80 percent empty. Braniff's Concorde service was canceled in May 1980.

For more information, go to the Web site www.concordesst.com *and look in the "History" section.*



Steamed Over Omission

In "Ba-da-boom" (Soundings, Oct./Nov. 2003), Bill Sweetman states: "On only five occasions in history has a propulsion system entirely new to aviation lifted an airplane off the ground." I can add a sixth: steam.

According to Floyd Clymer's *Historical Motor Scrapbook, Steam Car Edition*, vol. 1, George and William Besler fitted a Travelair with a two-cylinder, V-configuration steam engine. On April 20, 1933, at the San Francisco Bay Airdrome, the Travelair took off. The steam plant developed about 90 horsepower, enabling the aircraft to cruise at about 100 mph. The flight was nearly silent except for the noise of the propeller.

Upon landing, the pilot reversed the engine, stopping the aircraft in very short order. (Was this the first use of reverse thrust to slow or stop an aircraft upon landing?) I also read elsewhere that the pilot was able to taxi the aircraft to its hangar, turn, and back it into the hangar under its own steam (literally).

Allan Phillips
Tunnel Hill, Georgia

Correction

Dec. 2003/Jan. 2004 "The National Air and Space Museum's Steven F. Udvar-Hazy Center": The Northrop N-1M was the first flying wing airplane in the United States. The first flying wing in the world was built by Reimar and Walter Horten in Germany and flown in 1937.

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e-mail: editors@airspacemag.si.edu. *You must include your full name, mailing address, and phone number.*

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All letters selected for publication are edited. We regret that we cannot respond to every letter.

CLOUD 10

Where Every Night's Sleep is a Perfect 10

I had a great night in bed last night...I slept!

CLOUD 10 has found a way to give you the same great sleep technology as a $2500 visco-elastic foam mattress for a price starting at less than $100

There is a revolution going on in the bedroom. It's not between the sheets...it's under them! The sleep surfaces of traditional metal spring mattresses are proving to be a hindrance to a good night's rest. So for the 40 million Americans who have difficulty sleeping, your best bet—until now—has been to buy a new visco-elastic mattress. Visco-elastic foam uses a technology first developed by NASA to make the most comfortable sleep surface ever. The only problem is that these mattresses routinely cost about $2500 for a queen size. Most of us wouldn't sleep well if we added that cost to our credit card!

If you own a decent mattress, don't throw it out—make it better! Add the CLOUD 10 Mattress topper and rejuvenate that mattress. The CLOUD 10 is a mattress topper made from 2 inches of heat sensitive visco-elastic memory foam. This material reacts to your body temperature, so the surface stays cool in the summer and warm in the winter. It creates a contoured surface that cradles your body and helps eliminate those pressure points created by traditional mattress surfaces. When we tried the visco-elastic foam mattress topper, the feeling was incredible. "My neck and back felt as if they were floating and the pain in my aching joints was reduced. Even my legs were much more comfortable."

The CLOUD 10 mattress topper lets you experience the most restorative sleep for 90% less cost than a visco-foam topped mattress.

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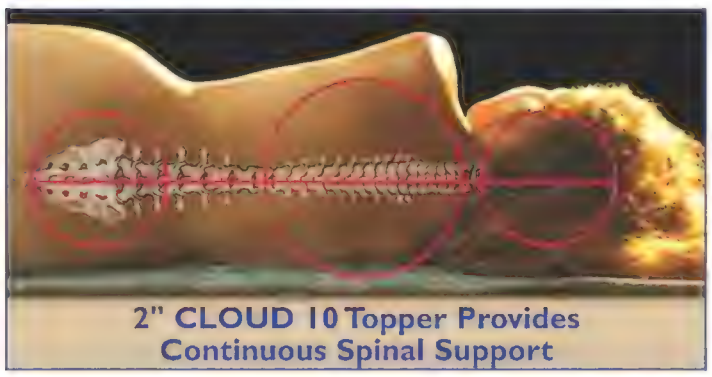

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Concorde, Unplugged

It was a record of sorts—the slowest two-day trip ever made by a Concorde. It took six hours for British Airways' G-BOAD, sitting on a barge, to float from Kennedy International Airport to Manhattan's Intrepid Sea-Air-Space Museum, which is anchored in the Hudson River off midtown Manhattan. Average speed: three knots, not including an overnight stay near the Verazzano Narrows Bridge. That's nowhere near the speed record a Concorde set flying from New York to London in 1996: 2 hours, 52 minutes, and 59 seconds, an average speed of more than 1,250 mph. And that Concorde was full of passengers.

Getting G-BOAD on the barge was an accomplishment in itself. In the wee hours of November 24, when Kennedy Airport was closed, workers walked the decommissioned SST, which had been drained of all fluids, from the runway to Sheepshead Bay in Brooklyn, a trip of three miles. At high tide—5:30 a.m.—they used two cranes to hoist the 66-ton jet onto the barge for its leisurely cruise.

A little under 28 hours later the barge arrived at its new home, where workers tied it down beside the Intrepid aircraft carrier/museum in a spot once inhabited by the destroyer USS *Edson*, which was sent back to the Navy to make room for the Concorde. After G-BOAD was safely anchored, the speechifying began. Miss USO sang "The Star Spangled Banner," and after five American speakers, the British speaker, Deputy Consul General Duncan Taylor, took the dais.

By the time the Concorde exhibit opens this spring, the British Airways SST will be on a different barge. An artifact itself, the barge transported Saturn V rocket segments to Cape Kennedy at around the same time the first Concorde took off. The Intrepid's Concorde will be the only one in the United States in which people can wander—not that they'll actually be able to wander much. "The cockpit is very cramped," says Tom Tyrrell, Intrepid museum director. "You really have to turn sideways to get access to it. An average size person can walk inside the cabin."

A high-speed Concorde on a slow boat to midtown: This British Airways supersonic tranport navigated New York Harbor on its final journey last November to the Intrepid Sea-Air-Space Museum, where visitors will be able to enter the cockpit.

Despite protestations from a few groups who want at least one Concorde to remain flightworthy, it looks as though they're all destined for museums. Virgin Atlantic CEO Richard Branson offered to buy one from British Airways and keep it flying, but at the same price that the airline paid the British government: £1. (The aircraft was so expensive to operate that the British and the French governments had to give it away to force the flag carriers to fly it.) Not surprisingly, BA shot down Branson's offer. So G-BOAD will sit on its barge, open to the public, exposed to the elements, its paint slowly oxidizing. "We're coming up with plans to protect it from damage," says Tyrrell.

In all, a dozen Concordes were parceled out to museums around the world. Stateside, you can see them at the Intrepid, the National Air and Space Museum's new Steven F. Udvar-Hazy Center at Dulles airport in northern Virginia, and the Museum of Flight in Seattle. But bits and pieces of the fleet saw wide distribution to bidders at the airlines' recent auctions, the proceeds of which went to charity. A wool blanket brought $2,000; two passenger seats, $15,500; and a nose cone went to a New York resident, who proclaimed it a good deal at $550,000.

—Phil Scott

UPDATE

X-Hunter: Bingo!

X-plane hunter Peter Merlin ("The X-Hunters," Feb./Mar. 1995) has zeroed in on the crash site of a highly classified Lockheed A-12 that went down in May 1963 and was reported as a lost F-105. CIA pilot Ken Collins had wound up in an inverted spin near Wendover, Nevada, and ejected from ship 123 about a year before the YF-12A Blackbird was unveiled. Most of the wreckage was removed in secrecy. On Merlin's second visit to the area he suspected was the site of the crash, he retrieved bits and pieces of what turned out to be a P-47D that had crashed in 1944. On his third visit, in October 2003, he says, "I hiked the desert for eight hours without anything to show for my efforts but an old horseshoe. Maybe it brought me luck." He next spotted a flat piece of metal with tubing attached and saw he was in the middle of a debris field of titanium fragments. "As usual, materials, part numbers, inspection stamps, and recognizable components confirmed the identity—it was the A-12," he says.

The King of Wichita

About the time the Beatles verged on world stardom, a brand-new King Air, serial number LJ-1, rolled off the Beechcraft production line in Wichita, Kansas, with a manufacturing plate dated October 30, 1963. In January 1964, King Air model 90 lifted off the Beech Field runway, and later that spring gained certification. The twin turboprop, the first of a generation of reliable and efficient smaller aircraft, was reasonably priced for both business and recreational users, and its appearance was a minor revolution for corporate aviation—the first opportunity to operate a single-pilot, turbine-powered, pressurized, heated and air-conditioned aircraft.

Forty years later, King Airs are still flying all over the world. "It's a go-anywhere, do-anything aircraft, an SUV of the sky," says spokesman Tim Travis of Raytheon Aircraft, which bought Beech Aircraft in 1980. "King Airs are used in all U.S. military branches and by governments all over the world for air ambulance, maritime control, and electronic surveillance." Nearly 6,000 King Airs have been manufactured, and some 5,000 still are flying. Production has not halted in four decades. In 1964, King Airs cost $300,000; today's three models range from $2.9 to $5.8 million.

Olive Ann Beech, wife of company founder Walter Beech, headed Beech when the King Air was developed. By the 1960s, the manufacturer had produced the elegant Staggerwing, Twin Beech, Bonanza, Mentor, and Baron. King Air LJ-1, registered as 925X for her September 25 birthdate, became Olive Ann's aircraft of choice for business trips.

To mark its decades of service, the first King Air will circle the globe this summer, thanks to Mississippi native and entrepreneur Alex Major, who co-owns the aircraft with Fred Pasternack, a New York physician and aviation enthusiast.

RAYTHEON

The Beechcraft King Air was the darling of business fliers when it debuted in the mid 1960s.

Major has owned 925X since 1985, when his company bought it for corporate transport. Pasternack became a partner in 1990 to aid in funding its preservation.

Major is first supervising a complete restoration of the airplane at The Hangar, Inc., in Batesville, Mississippi. The two owners will fly the 30,000-mile trip in 30 four-hour, thousand-mile legs, some with celebrity guest pilots (actor and Mississippi resident Morgan Freeman has signed up for a leg in Russia). The six-week flight will "honor the aviation history of the King Air as well as the memories of Olive Ann and Walter Beech," says Major. Once the trip is accomplished, Major plans to donate LJ-1 to an air museum.

—Robert G. Pushkar

TWA 800's Legacy

On July 17, 1996, at 8:19 p.m., Trans World Airlines flight 800 lifted off from New York's Kennedy airport, its 212 passengers and crew of 18 en route to Paris. Some 11 minutes into its climb, the Boeing 747-131 exploded, its pieces falling and sinking to the ocean floor near East Moriches, New York. All 230 lives were lost. By August 2000, in a rented Grumman hangar in Calverton, Long Island, the National Transportation Safety Board had completed the largest reconstruction of a civilian aircraft for an investigation of what had brought TWA 800 down. NTSB chairman Jim Hall announced the accident's probable cause as an explosion of the center wing fuel tank due to ignition of vaporized fuel, likely caused by a short circuit from the fuel-level sensing system that allowed excessive voltage to enter the tank through electrical wiring.

Although wreckage most often becomes the property of insurers, the federal government took possession of TWA 800 because it was recovered by the Navy and Coast Guard. The NTSB became the "owner" of the reconstructed fuselage, which it now uses to train future investigators at the NTSB Academy in Ashburn, Virginia, which opened last August.

Larry Jackson of the NTSB office of engineering talks of lessons learned from the British reconstruction of a Pan Am flight that exploded over Lockerbie, Scotland. That project relied on wheeled scaffolding, which proved awkward. "For TWA 800 we developed a new idea: a bridge truss," he says. "It was built knowing that this would eventually be

The reconstructed remains of TWA 800 now train a new generation of National Transportation Safety Board investigators.

JAY L. KIVOWITZ/NTSB

TOM TURNER/AP/WIDE WORLD PHOTOS

moved from Calverton."

Steel mesh was molded around the truss in the shape of the aircraft; 876 recovered pieces formed the fuselage. Each piece was identified by the date it was recovered, where it was found, who had hung it on the frame, and any changes made during mounting. "We had to drill holes to place pieces on the gridwork, and we painted those [holes] in orange," says Jackson. "Some of that tracking system also helped the work on our structures database," which is a record of failed components, their composition, and the forces that caused the failures. The seats underwent comprehensive testing by the NTSB survival factors group; now all will be reinstalled to the original configuration.

Jackson's team first considered towing the 100-foot truss with the fuselage intact to a seaport for shipment by barge. Says Jackson, "We also considered the CargoLifter," a heavy-lift airship that has since fallen into receivership. The team eventually sliced the truss into sections that could be shipped in containers on open trailers.

The wreckage was fully reassembled in the academy hangar last December. When first recovered, each piece was

UPDATE

DARRELL OHS

Mars Bombers Bounce Back

The two Martin Mars water bombers based in British Columbia broke their old record for firefighting time last year, logging 293 hours fighting 66 local fires ("Last Call for the Martin Mars?," Soundings, Dec. 2000/Jan. 2001). The vintage flying boats' best year had been 1967, with 272 hours. The new record comes just two years after the Mars, which are operated by Forest Industry Flying Tankers, were grounded due to slack fire seasons and the aircraft's high fees: $15,000 per hour, or $26,800 for both the *Hawaii Mars* and the *Philippine Mars*. Logging company TimberWest, which now reviews the FIFT program on a year-to-year basis, will rely on the fleet in 2004.

WORK IN PROGRESS

USAF MUSEUM

The U.S. Air Force Museum at Wright-Patterson Air Force Base in Dayton, Ohio, invites visitors to come take a good, long, up-close look at its "vintage" B-2 stealth bomber—as well as its 300-plus air- and spacecraft.

Like-New B-2

Last December, the U.S. Air Force Museum in Dayton, Ohio, rolled out its latest restoration—a B-2 stealth bomber. "Conversion" may be a better term than "restoration," since the aircraft is neither a veteran nor a fully functional aircraft, but a "test article" used to evaluate the structural integrity of the airframe. "This will be the only place in the world where the public can see a B-2 up close," says Air Force Museum director Charles Metcalf.

The test article arrived at the museum disassembled for transport, with some pieces weighing nearly 70,000 pounds. The restoration team "put together one of the world's largest jigsaw puzzles," says Metcalf. The re-assembly, which took three years, included patching and filling a large crack in the skin that formed during an intentional test-to-failure. While the interior lacks a suite of avionics, the exterior replicates that of a working B-2.

The aircraft is not officially retired. B-2 program officials plan to call it back to work for occasional structural testing involved in future improvements to the fleet.

Air & Space is unable to publish photographs of the ongoing restoration. These photos are classified, since they may reveal what the Air Force calls "sensitive areas."

rinsed of saltwater, but Jim Wildey, head of the NTSB materials lab, says that at depths of more than 100 feet, the low percentage of oxygen prevented much deterioration. Now, seven years later at Ashburn, puddles form on the concrete floor from water used to rinse off the signs of years of storage, such as the bird droppings that afflict all large hangars.

Investigators in training will be able to walk through, beneath, and well above the reconstruction from the hangar catwalk. The truss was fitted with electrical power and lighting by a reconstruction and engineering team that specializes in bridge work. Out of respect for the families of the victims, TWA 800 will remain out of view from all but NTSB scientists, serving as the focal point of training for the next generation of investigators.

The academy is 80 percent laboratory, along with classrooms, the 100- by 300-foot hangar, and a simulations area in which to house or reconstruct NTSB artifacts like huge sections of pipeline or train cars that do not need to be kept out of view. The first course held in the facility, "Family Assistance During Transportation Disasters," concluded on September 11, 2003. Some 20 other courses include accident site photography, transportation disaster response, and aircraft performance.

Until more of the NTSB's 400 staff members shift to Ashburn from downtown Washington, TWA 800 shares the vast space with only a handful of employees, and its hangar with a gutted Cessna 152 still holding charred remnants of a Pilot Operating Handbook.

—Roger A. Mola

Airport 1, Park 0

After George W. Bush's contested victory in Florida's 2000 election, voters last November cast their ballots three to one in favor of keeping St. Petersburg's Albert Whitted Municipal Airport from being replaced with a beachfront park.

While rejecting a park sounds like another punch-card-ballot malfunction, Jack Tunstill, vice chairman of the city's airport advisory committee, says the city fathers may have had a nefarious plan for the 110 acres: Had the voters not rejected the proposal, half of the land could be sold to developers in 2011.

But what moved the voters, according to airport operations supervisor Sheri Weaver, wasn't the prospect of high-rises or the fact that the airport takes in $21 million a year and provides 300 jobs. "It was mostly history that people connected with," she says. Whitted was the birthplace of scheduled airline flights. In January 1914, Tony Jannus started daily passenger flights in his two-seat Benoist flying boat from St. Petersburg's shores to Tampa, a 25-mile, 23-minute flight. His first passenger, Mayor A.C. Phile, ponied up $400, a figure approximately the annual wages of the average working stiff, for the honor. The airport was built later, in 1928, and six years after that, National Airlines began scheduled flights to and from it. Goodyear built a big hangar for its blimps there in the late 1930s. During World War II, the field, named for a naval aviator, became a Navy pilot training base.

The *St. Petersburg Times* was anti-airport almost from the beginning, says Weaver. "The publisher and the man who ran National Airlines had a personality clash," she says. The cause of their mutual loathing is still unclear.

"Maybe it stemmed from crazy rumors of fistfights and furniture being thrown out of offices," Weaver adds.

Now the battle's over. "When 73 percent of the people say they want this airport, the politicians are smart enough to say 'We're not going to come back to this again,' " says Tunstill. Part of the victory he attributes to the area's new electronic voting machines: "It was real clear. I guess people figured out how to vote in Florida."

—Phil Scott

RANDY YORK

Saved by the voters: Florida's historic Albert Whitted Municipal Airport on the bay in St. Petersburg.

UPDATE

SCALED COMPOSITES

Rutan Goes Supersonic

Last December 17, quietly upstaging the Wright Flyer reproduction takeoff attempt, Burt Rutan's SpaceShipOne ("From the House of Rutan," Soundings, June/July 2003) went supersonic after being launched from the White Knight turbojet carrier aircraft at 48,000 feet over the California desert.

After release, SpaceShipOne pilot Brian Binnie glided to a stable .55 Mach, fired the hybrid rocket motor, and climbed like a scalded cat. Fifteen seconds after ignition, the motor shut down on schedule, while SpaceShipOne continued to climb, reaching nearly Mach 1.2 and 68,000 feet. Binnie configured the vehicle to a high-drag "feathered" profile for a one-minute descent, then re-configured it to a glider for 12 minutes before landing at Mojave Airport. The left landing gear retracted on touchdown, causing SpaceShipOne to veer off the runway, but damage was minor.

SpaceShipOne is Rutan's design to win the X Prize, $10 million awarded to the first group to launch a three-seat suborbital spacecraft to an altitude of 62 miles twice within two weeks.

My Ride on the Concorde

As the National Air and Space Museum's curator of air transportation, I am responsible for the Museum's collection of 16 transports, which includes a Ford Tri-Motor and a Douglas DC-3. The most recent addition to our collection is one of the most beautiful aircraft ever built: the Concorde.

Both Air France and British Airways ended their Concorde service last year, but not before the technological marvel had transported an elite clientele in a way the rest of us could only dream about. The Concorde, which was created jointly by British and French engineers, began service in January 1976, flying passengers at twice the speed of sound. Such speed didn't come cheap, though: A transatlantic flight required the high-maintenance aircraft to gulp jet fuel at the rate of one ton per seat, and the average round-trip price was $12,000. Eventually, the tough airline marketplace forced Air France and British Airways to cut back their already limited service; routes from London and Paris to Washington, D.C., Rio de Janeiro, Caracas, Miami, Singapore, and other locations were cut, leaving only transatlantic service to New York. And even on most of these flights, Concordes flew only half full, with many of the passengers flying as guests of the airlines or as upgrades.

By 1989 airline executives realized that the aircraft's days were numbered, so Air France promised to eventually give one of its Concordes to the Smithsonian Institution. Last April, Air France president Jean Cyril Spinetta informed us that the airline would end Concorde service on May 31, and that we would receive a Concorde in June. By remarkable coincidence, I was scheduled to be in France on business in mid-June, and therefore available to represent the Smithsonian on the Concorde's retirement flight.

Air France scheduled its last transatlantic Concorde flight for June 12. While it was actually a ferry flight to the Museum's Steven F. Udvar-Hazy Center at Dulles airport in Virginia, Air France treated this one no different from its regular Concorde flights. In other words, Flight 4386 would be magnificent. Sixty people, including France's transport minister, several past Air France presidents, and former Concorde pilots and crew members, would be on board. Mstislav Rostropovich, the famed cellist who always flew the Concorde with his cello in an adjacent seat, was to make the flight as well.

ERIC LONG

The Concorde's arrival at Washington Dulles Airport last June 12 proved an irresistible photo-op for its crew and for Henri Courpron (left), president of Airbus North American Holdings, and Steven F. Udvar-Hazy, who donated $65 million for the building of the new facility that bears his name and that now houses the Concorde.

The flight was scheduled to leave Paris' Charles de Gaulle airport at noon. I was instructed to arrive at the Concorde desk at 10 a.m., but I arrived an hour early. My first hint that this was to be a special experience came as I was led to the front of the Customs line and whisked through while dozens of coach passengers waited and wondered who that person was who had just sailed past the authorities.

The privileges continued when I arrived at the Concorde lounge: Air France had created a beautiful waiting area (separate from the airline's first-class lounge) with all the amenities. I checked in and received my ticket, along with a luggage tag and a special commemorative package. I had walked into a party; champagne was everywhere.

Several French passengers stressed to me how honored they felt that the Smithsonian was accepting one of their Concordes. The aircraft had occupied a place in the hearts of the French people, and they felt both great pride and great sadness when the end had finally come. Despite the political strains our countries' relationship had recently endured, I was happy to tell them that there was no gloating by Americans over the demise of Concorde; everyone I knew appreciated the technological brilliance and beauty of the aircraft.

I was thrilled to learn that the Smithsonian would receive Concorde F-BVFA, the pride of the Air France fleet. It was the first Concorde in service with the airline and the one that had the most flight time: 17,824 hours.

At 11:30 a.m. the party moved from the lounge through a checkpoint and down a jetway to the waiting airliner, which had been parked outside the window of the lounge for all to see and photograph one last time. Despite the festive atmosphere in the lounge, the day was a gloomy gray, with rain pouring down on the wings and fuselage. Before we entered the airliner, the cabin crew politely warned us to duck as we walked through the surprisingly small doorway. I had been

ERIC LONG/COURTESY U.S. PARK POLICE

On November 20, the space shuttle *Enterprise* was towed from storage at Dulles airport in northern Virginia to its new home: the James S. McDonnell space hangar, which is part of the National Air and Space Museum's Steven F. Udvar-Hazy Center. Though the Udvar-Hazy Center's aviation hangar opened December 15, the McDonnell space hangar is closed through June while the *Enterprise* undergoes restoration.

assigned a seat in the forward cabin, where, during Concorde's heyday, the elite had insisted on sitting. I was told several tales of temper tantrums by disappointed rock stars, who had been assigned seats in the rear cabin.

At noon the doors were closed, the four Olympus engines fired up, and the aircraft pushed back from the gate. Captain Jean-François Michel, head of Air France's Concorde division, First Officer Gérard Duval, and Flight Engineer Jean-Yves Dronne were in the cockpit. As we taxied by the terminal, I looked out my tiny window and noticed hundreds of airport workers along the ramp, waving and filming our departure.

After getting takeoff clearance, Michel lit the afterburners for 30 seconds, and the Concorde responded by accelerating down the runway to 225 mph; after rolling less than 5,000 feet, we were airborne. As we climbed, the Concorde continued to accelerate, and after 19 minutes, we reached the French coast. We were at 25,500 feet, traveling at Mach .75, when the fuel transfer process began. (Because the Concorde's aerodynamic center shifts as it transitions to supersonic speeds, high-speed pumps redistribute the fuel to compensate.) Once the fuel transfer was completed, Michel again ignited the afterburners and we continued to accelerate, leaving the English Channel behind.

With my eyes glued to the Mach meter on the forward cabin bulkhead, I watched as our speed increased, anticipating some kind of bump that would signify we had gone supersonic. I was pleasantly disappointed.

Thirty-five minutes after takeoff, we were 272 miles from Paris. At this point, the afterburners were shut down and cabin service begun. While there were only 60 passengers, we were tended to by seven flight attendants. As one would expect, the service was superb. Catherine Pellerin, a Concorde cabin crew instructor, was responsible for my section. I was sitting next to P. Girandet, a delightful elderly gentleman who I later discovered was the president of Air France when the Concorde entered service in 1976. He was polite but demanding of Pellerin, who responded with great attention and a caring smile for her former boss.

While dinner was being prepared, Pellerin brought caviar and champagne. Girandet explained to me in broken English that it was just unthinkable to serve champagne with caviar. What did I know? I'm a middle-class civil servant from the suburbs. Apparently, caviar should only be accompanied by vodka. I'll remember that next time.

Next came an hors d'oeuvre, a choice between medallions of rock lobster with crab sauce or fois gras with chutney and carrot jelly. I chose the lobster, which was accompanied by a white wine.

Between courses I looked up and saw that we had reached Mach 2—1,350 mph, faster than Earth rotates. Our altitude varied between 52,000 and 59,000 feet, far above the rest of the air traffic. I noticed that my window was quite warm, and I could feel heat radiating from the fuselage, whose aluminum skin had heated to over 248 degrees Fahrenheit. The sky above us was a stunning dark purple. I tried to see the curvature of Earth, but to my dismay the entire Atlantic was clouded over.

My disappointment was soon forgotten with the arrival of pan-seared veal medallions, Maxime potatoes, and a rich Bordeaux. My place setting consisted of fine china, engraved glassware, and silverware—except for the knife, which, for security reasons, was plastic.

With the arrival of dessert—seasonal fruit timbale, petits fours, and a selection of fine cheeses—we began our descent. We had flown supersonically for two hours and 57 minutes; in the time it had taken to have dinner, we had crossed the Atlantic. Before I knew it, we were preparing to land. With the aircraft pitched high and its nose visor lowered for a better view, we made a straight-in approach to Dulles, landing smoothly at 170 mph. The entire flight had lasted just three hours and 49 minutes.

Though I was exhilarated with my supersonic experience aboard F-BVFA, I was saddened that it would never again fly. The Concorde was clearly superior to conventional airliners—if only you could afford the ticket. And few could, which is why we're unlikely ever to see an airliner like the Concorde again. But at least F-BVFA will be preserved forever.

—F. Robert van der Linden

VISITING THE UDVAR-HAZY CENTER

Hours The Steven F. Udvar-Hazy Center is open from 10 a.m. to 5:30 p.m. every day except for December 25. Admission is free.

Location The Udvar-Hazy Center is south of the main terminal at Washington Dulles International Airport in northern Virginia, near the intersection of routes 28 and 50.

Parking Daily parking is $12; a year-long parking pass is $50. School and tour buses park free.

Getting There Buses shuttle between the National Air and Space Museum on the National Mall in Washington, D.C., and the Udvar-Hazy Center. Buses depart both locations at 9 a.m., 10:30 a.m., noon, 1:30 p.m., 3 p.m., and 5 p.m. Round-trip fares are $7 per passenger and $5 per passenger for groups of 10 and more.

Security All visitors and their bags will be screened. School groups are advised to leave all unnecessary belongings on the bus.

For more information, call (202) 357-2700 or visit *www.nasm.si.edu/museum/udvarhazy*

Leave it to the Beaver

In the summer of 1954, I was the commander of A Flight, 521st Aviation Company, part of the U.S. Army's 30th Engineer Topographic Battalion. We were assigned the five-year mission of mapping the entire state of Alaska, due to Cold War fears of a Soviet attack from the north. We were based at an old Air Force flight strip across the Kuskokwim River from Bethel, with a fleet of 21 Hiller H-23 D light helicopters and three de Havilland DHC-2 Beavers (L-20s in Army parlance).

By then I had accumulated about 2,500 hours of flying time, 1,000 of it in helicopters and the rest spread over a variety of light Army aircraft, like the Convair L-13 Grasshopper and Cessna L-19 Bird Dog, as well as a North American Navion that I had ditched in San Francisco Bay in 1951 after taking off from Chrissy Field with a tank of contaminated fuel.

The Beaver had a hatch in the floor and a side door big enough for 55-gallon drums to be rolled into the cabin, and we had the capability to add oil to the engine in flight. The airplane could fly as slow as 45 mph and take off in less than 400 feet, good short-takeoff-and-landing performance for our work in Alaska. We equipped our L-20s with wheels, skis, or floats as needed.

One afternoon in late August I got a radio call from the Air/Sea Rescue unit at Kodiak. A 19-year-old Cup'ig tribe girl on Nunivak Island had been in labor for several days and was near death. The family had tried to charter a commercial aircraft to take her to the hospital at Bethel, but the local operators refused because of Nunivak's persistently bad weather. As a last resort, they called the Air Force, but its large Grumman seaplanes drew too much water to land in the shallow waters off Mekoryuk, the main village on the island. Air/Sea Rescue asked if I would use one of my float-equipped Beavers to pick up the girl. Mekoryuk was at the mouth of Shoal Bay on the north shore of Nunivak, about 150 air miles west of Bethel. I said I would bring an Army doctor assigned to our unit.

I had the L-20 topped off with fuel and loaded with extra gasoline cans for refueling at Mekoryuk, and also had two seats removed to make room for a litter. I then called the doctor, an Army captain, and told him to prepare for the flight.

What would have been a comparatively simple flight in daylight had been complicated by the approaching darkness. At the time, there were no electronic navigational aids in the area. We did have a radio beacon at the base, but it was so weak we could receive it only in the airstrip's traffic pattern. Although the Beavers had radios, they were good only for communicating with control towers and en route

In the 1950s, the author (above, at left) and his crew chief depended on the short-takeoff-and-landing performance of the sturdy de Havilland DHC-2 Beaver, which could be equipped with floats, skis, or wheels to conduct various missions to remote Alaskan outposts (right).

MAP: COOL FIRE TECHNOLOGY/BRAIN BANK 2003; PHOTO: COURTESY E. NEWPORT

navigational facilities. A flier had to be well versed in the art of pilotage—navigating by checkpoints and timing—to get around in Alaska's endless tundra. (One of my regular checkpoints was a bleached caribou skull.) We also regularly flew our Beavers at 1,000 pounds over gross weight. If it didn't sink, it would fly. Finally, weather information was non-existent or too vague to be useful.

Shortly after leaving Bethel, the darkness and the lack of distinctive ground features left me with few checkpoints on my route. I prayed that the coastal fog would not have moved in by the time I got there. On reaching the coastline, I turned left to hit my checkpoint, a large, easily identifiable bay that stood out in the available light. But the thick fog had moved in and was lying just offshore. Should I proceed on course above the fog, hoping that the island would be in the clear when I arrived, or fly on the deck, under the fog layer, hoping I would see the island before I literally ran into it? The idea of flying on top of the fog and descending on instruments where I thought the island to be, without navigational or approach aids, was not appealing. I decided to fly under the fog.

Initially the ceiling under the fog layer was probably 50 to 75 feet, plenty of room for the Beaver. However, the loss of the starlight and moonlight had made things so dark, except where the fog thinned a little, that I turned on the landing light to see the water. This worked well except where patches of fog actually touched the water and reflected the blinding light back up at me.

I considered an open-water landing and either taxiing to the island or waiting until the fog cleared. Then the fog lifted a little and I continued through the narrow gap between ocean and cloud. Eventually, I could see the island and lights of Mekoryuk dead ahead; magically, a hole opened in the fog, exposing Nunivak.

In the waning light, I landed in the bay and taxied to the floatplane dock. The only real hazard now was the possibility of hitting a floating log or other invisible obstruction. My heart didn't stop pounding until the airplane came to a stop at the dock.

The entire village was waiting on shore. (Even today, Mekoryuk has little more than 200 inhabitants.) Many helping hands made quick work of mooring the airplane, and the doctor and his gear were quickly loaded into a truck and hustled to the infirmary. I stayed with the Beaver to make sure everything was secured and then followed the doctor. On the way, I was told that the girl had started to give birth.

When I arrived, the baby was just emerging and the doctor, assisted by a midwife, was attempting to ease the transition. The mother appeared exhausted and the baby was blue from lack of oxygen. Once the baby was born, she was cleaned up, wrapped in a towel, and handed to the mother. At that point, I thought that while the mother might survive, the baby would probably not; at the least, I figured she would have brain damage from oxygen deprivation.

Immediately following the birth, the doctor asked me to try to find a supply of oxygen. I found the girl's husband pacing the hallway, and together we discovered a tank of welder's oxygen and wheeled it into the room. The doctor attached a rubber hose to the tank, opened the valve, and held the tube under the baby's nose. In just a few minutes she underwent an amazing transformation—her coloring changed from blue to pink, and she started to cry. The doctor had probably saved the mother's life and had given the baby a fighting chance. While he performed some post-delivery surgery, I flopped on a cot and attempted to get some sleep. Although I probably dozed off a few times, I think I flew that Beaver over the Bering Sea all night.

Early the next morning, after fueling the airplane, I loaded the doctor and his two patients into the Beaver and headed back. The floatplane dock at Bethel was on the Kuskokwim River, opposite my home base. I landed and tried to taxi to the dock. Even though the swift current swept the aircraft downstream, we managed to make it to the dock, where an ambulance was waiting to take my passengers to the hospital. While waiting for the medical attendants to offload them, I was approached by one of a group of local bush pilots, who accused me of taking the bread from their childrens' mouths by making the emergency flight. I considered his statement for a moment, then pointed out that the pregnant girl's family had spent five days trying to hire someone to fly her to the hospital. The irritated pilot walked away without further comment. I untied the airplane, flew back to my home base, and went to bed.

In the decades since this flight, I sometimes wondered what had become of the family on Nunivak. I went on to serve two tours in Vietnam, spend seven years at the Pentagon, and take assignments around the world. Last year, with the assistance of Robert Drozda, cultural consultant to the Village of Mekoryuk, I was reunited via the Internet with a Ms. David of Anchorage, formerly the struggling baby we had helped deliver 50 years ago. I now have a new pen pal.

—Colonel E. Newport, U.S. Army (ret.)

The Education of a Ramp Rat

One Saturday morning in the early 1970s, when I opened the hangar doors at Lakeland Regional Airport in Florida, a spaceman was on my ramp. Dressed in a silvery pressure suit with a helmet and air-conditioning suitcase like the ones the astronauts used, Kingswood Sprott was about to attempt a new high-altitude record for hot-air balloons. The ramp was covered with media types, who cluttered the flightline with cameras, candy wrappers, and cigarette butts. (If I recall correctly, burner problems prevented Sprott from succeeding that day.)

This sort of thing is what made lineboy the best aviation job I've ever had—including my grown-up job as an airline pilot.

I never knew what to expect when I opened Lakeland Flying Service every day. One morning there were 15 Huey helicopters on the ramp that had come from MacDill Air Force Base to buy fuel on Double Green-Stamp Day, when the office doled out twice the normal number of S&H Green Stamps per gallon of fuel purchased. Another time, I slid open the hangar doors to see a Boeing 727 bearing an angry presidential hopeful, Hubert Humphrey, who couldn't get off the airplane at the forward exit because our little airport didn't have airstairs for such a large airliner.

From the time I opened the hangar at 7 a.m. until the owner and another lineboy showed up around 10, I more or less owned the airport. Once the doors were open and I had brewed the coffee, my kingdom was serene—until a swarm of Cessna 182 and Piper Tripacer drivers and pre-solo students descended on the office asking for their aircraft to be pulled out of the hangar or for a fuel top-off.

Most pilots were proficient, professional types. Only the idiots stand out in memory. Like the Cessna 411 owner who jumped into his airplane and started the right engine while I was still behind the propeller, adding engine oil. I scurried under the wing to safety as he taxied away. He needed all the power he could get to break free because the airplane was still chocked and tied down. He took off with tiedown ropes trailing from both wings and an oil can poking out of the cowling. Or the owner of a Luscombe who thought tossing lit cherry bombs at the fuel truck—while I was refueling a DC-3—was a lively way to celebrate Independence Day. Two of the little bombs exploded on the top of the truck's 2,000-gallon tank. (Luckily, nothing else exploded.)

WAYNE SHIPP

We lineboys got perks that even the airport's professional pilots never saw. Flight instructors and charter pilots couldn't be spared to pick up new Cessnas from the factory in Kansas, but we lineboys could. Several times I flew Braniff (Tampa to Dallas to Wichita), carrying a change of clothes in a grocery bag, to pick up a new airplane—sometimes one loaded up with Coors beer, which my boss had ordered. Back then, Coors was not available in the east. He sold it to the college boys in Lakeland for $5 a can, which probably covered my Braniff ticket as well as the fuel I burned to get the Cessna back to Lakeland.

In the days of the three-martini lunch, business jets weren't used to "contain costs." They flew executives to Florida for a round of golf. As a lineboy, I was happy to see them—both for the half-cent-per-gallon fuel bonus I got for filling their tanks, and for the tips their crews handed out. The Philip Morris crew always tipped us with a carton of smokes.

Another perk was free flight time in the Cessna 150s. In the twilight hours after closing time, we flew in formation and engaged in mock dogfights. Gas for our motorcycles and cars was free too, if you didn't mind the 100-octane clogging your sparkplugs every other week. We could audit ground school, when they held one, as long as we sat in the back. (After a 12-hour day in the August sun, we didn't smell very good.)

As a lineboy, you learned everything by doing. We worked in the shop, painted chocks, loaded patients into air ambulances, clambered over P-51s and Corsairs, and learned other, more practical things, like how to empty a Convair's toilet without getting showered with its contents.

Gently tugging at their tiedowns and rocking in the evening breeze, the airplanes were more calming to me than a cowboy's herd of lowing cattle. I think of the Boeing 767s I fly today as animate, but I've never had a conversation with an airliner quite as gratifying as the ones I had with those little Cessnas.

—Kevin Garrison

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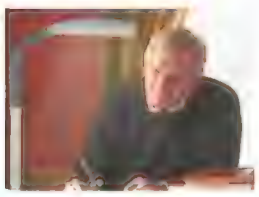

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Height as shown: 50"

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Glacier Girl

THE LIGHTNING THAT LIVED TWICE.

Bob Cardin is as prickly and no-nonsense as a piece of barbed wire. He is short and powerfully built, with a gravelly voice and a tough, working-class Rhode Island accent. He gets to work at seven every morning, seven days a week, and doesn't go home until the job is done. I once saw him cut the back of his hand on a piece of sheet metal and he didn't flinch. He has no sense of humor. I have never seen him laugh. But at the Dayton Air Show I saw him go soft as a puppy.

He was standing in front of a Lockheed P-38 Lightning named *Glacier Girl*. A long time ago, Cardin's boss, J. Roy Shoffner, invested in a project to recover the P-38, which was buried beneath 268 feet of ice in southeastern Greenland. It was an audacious treasure hunt that had been going on for 13 years by the time Shoffner got involved, and he needed a tough guy to make it happen. Against the odds, Cardin and a well-equipped recovery crew pulled the fighter out on August 1, 1992 ("Iced Lightning," Dec. 1992/Jan. 1993). The P-38 was delivered to Shoffner's hangar in a little place called Middlesboro, Kentucky, and Cardin set to work. Years passed. Millions of dollars were spent. Not a few people, including both men's wives, wondered if Cardin and Shoffner were crazy. But almost 10 years to the day after the warbird emerged from its icy

BY CARL HOFFMAN

JOHN M. DIBBS/PLANE PICTURE COMPANY, INC.

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To extract the aircraft, workers had to carve a cave out of the ice. Why was Harry Smith's P-38 chosen and not one of the seven others? Belly-landed with engines turning, the other P-38s had damaged propellers (opposite). Only Smith turned his engines off. Each component was painstakingly lifted 268 feet to the surface (opposite, right).

tomb, the Lightning finally took wing. And nine months later, Cardin's prize was there at Dayton, spotless, surrounded by thousands of admirers. For the four days of the show, they crowded around Cardin and *Glacier Girl* 12 hours a day as if the gruff 56-year-old pilot and the 61-year-old airplane were Britney Spears and Madonna.

"Wow!" shouted a teenager.

"Sir, I've got to shake your hand," said a man, grabbing Cardin's tough brown mitt. "You've done a wonderful thing!"

"Thank you for bringing this plane out here," called another.

And suddenly Bob Cardin couldn't help himself. He was smiling. "Hi folks!" he blurted. "It's a beautiful day!"

"When I watch people look at the plane and then see the excitement that comes in their eyes when they recognize it," he told me, "that's when it's all worth it."

By now, *Glacier Girl*'s story is mythic. It was July 1942, seven months after the Japanese attack on Pearl Harbor, and U.S. factories were cranking out hundreds of aircraft a day. Getting them to the war wasn't easy. They could be shipped by sea, but Nazi Germany's submarines were sinking Allied vessels at an alarming rate. The obvious solution was to fly them, but in those days fighters didn't have the range to make the journey non-stop. So the U.S. Army Air Forces came up with Operation Bolero, a bold plan to ferry aircraft in stages, refueling at four newly constructed bases: Presque Isle, Maine; Goose Bay, Labrador; Narsarsuaq, Greenland; and Reykjavik, Iceland. Flying to these bases was tricky, though. The high latitudes played havoc with compasses and radios. And when the weather closed in, landing at airstrips in long, mountain-ringed fjords like Narsarsuaq was impossible.

On July 7, in the second flight of Operation Bolero, two formations, each consisting of four P-38s and a B-17, left Goose Bay, bound for Narsarsuaq (code-named Bluie West One), Reykjavik, and then Scotland. Over the next few days, weather separated the two formations, named Tomcat Green and Tomcat Yellow, but on July 15 they rejoined in Greenland and took wing for Reykjavik, minus two P-38s suffering mechanical failure. Once again, fierce storms blocked their way, so the eight airplanes headed back to Greenland, but by now their intended base was hidden by a heavy overcast. The pilots of Tomcat Green and Yellow had to land while they still had fuel to do so, through whatever hole in the clouds they could find. One by one, the airplanes came down on the ice cap that covers most of Greenland.

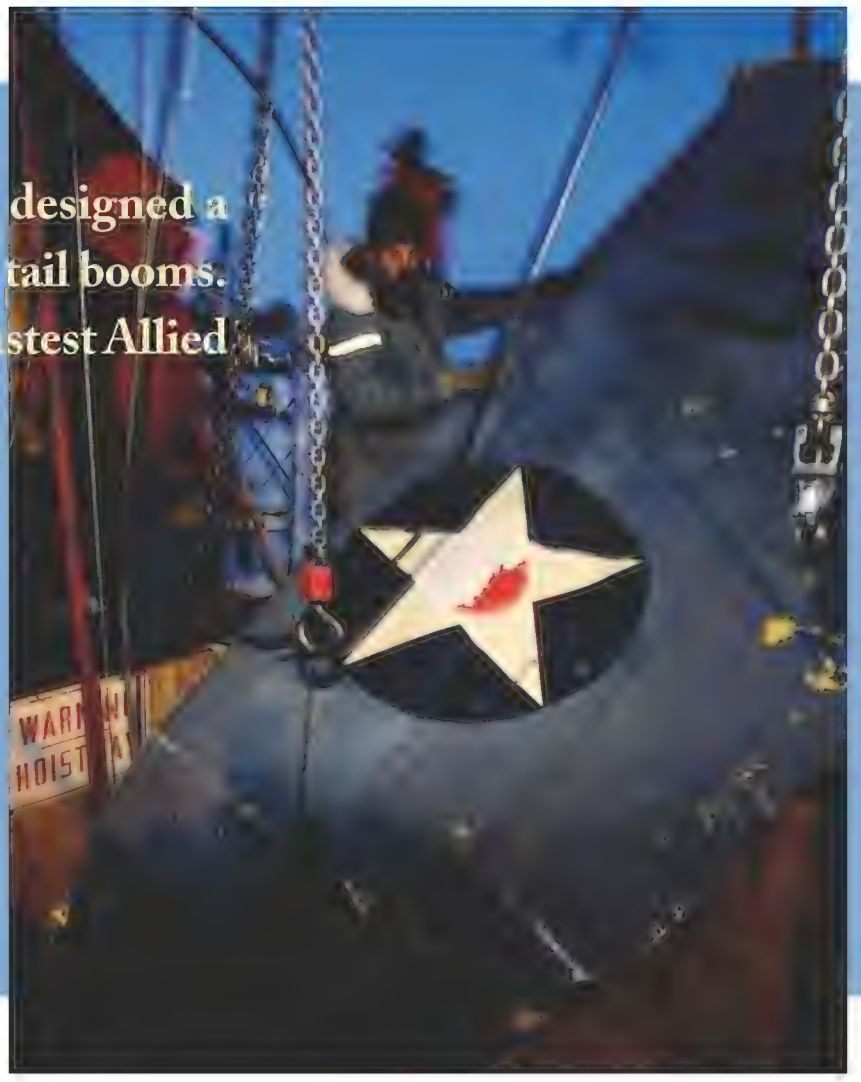
Brad McManus was the first to touch down. His P-38 flipped over after his landing gear made contact with the ice (McManus was uninjured), so the other pilots made wheels-up belly landings. Harry Smith's airplane was the last Lightning to land. In his logbook, a relieved Smith wrote of his P-38: "Best damn crate I ever damn saw." The airplane was 62 days old and had flown a total of 72 hours.

The pilots had plenty of food and even a case of clandestine whiskey—and that was fortunate because it took more than a week for a rescue party to arrive and lead them to safety. Harry Smith destroyed his top-secret Identification Friend or Foe radio with a few shots from his .45-caliber pistol, and he and the rest of the men hiked 10 miles to the coast and a waiting boat while dog sleds carried their gear. Their adventure was over, the airplanes abandoned and forgotten. The lost squadron, it seemed, would be a minor footnote in a long war.

By the time the war ended, the United States had manufactured 300,000 aircraft. Slightly more than 10,000 were P-38s, a fighter that, in the years after McManus and Smith landed on the ice, became a legend. Lockheed's first military aircraft to go into production, it was also the first single-seat, twin-engine fighter. In 1937 the Army Air Corps had sought designs for an interceptor that could reach 360 mph at 20,000 feet in six minutes. Lockheed's Kelly Johnson and Hall Hibbard had designed a radical machine: a big all-metal airplane with twin tailbooms, each housing a liquid-cooled turbo-supercharged Allison V-12 engine powering counter-rotating propellers. In the nose, four .50-caliber machine guns and a 20-millimeter cannon gave the "fork-tailed-devil," as the Germans called it, a devastating punch. Capable of slightly more than 400 mph, it was the fastest Allied airplane in the skies at the beginning of the war.

"Boy, was it a sweet airplane," says Bud Holecheck, 78, who flew Lightnings in low-altitude strafing and dive-bombing runs during the 1944-45 Battle of the Bulge. "If you got hit and lost an engine, no problem. You could do aerobat-

Lockheed's Kelly Johnson and Hall Hibbard had designed a radical machine: a big all-metal airplane with twin tail booms. Capable of slightly more than 400 mph, it was the fastest Allied airplane in the skies at the beginning of the war.



LEFT: COURTESY BRAD MCMANUS; RIGHT: © 1992 LOUIS A. SAPIENZA/GES

ics on one engine. When we returned from a combat mission, we'd show off. We'd come in at 350 feet and instead of peeling up, we'd peel right in a snap roll and put it on the ground in 30 seconds. Some guys could do it in 20. You couldn't do that in a P-51 or P-40. And you had so much firepower. When we'd come in on a locomotive, all five guns would hit at the same time. For pure aerial combat, the -51 has to be known as the best, but you put it together and the Lightning could do it all." (At the end of the war, Holecheck flew a loop around San Francisco's Golden Gate Bridge in a P-38.)

The lost squadron's Brad McManus, now 85, echoes Holecheck. Two years after his rescue from the ice he finally made it to Europe, where he flew 85 missions, first in P-38s, then in P-51 Mustangs. "Everyone who ever flew a -38 loved it," he says. "It was very smooth because the counter-rotating props eliminated torque, so you could roll and maneuver much better than [in] a Mustang. When it came time to transition from the -38 to the -51, no one wanted to." But in combat, McManus admits, "the -51 was better. After we transitioned, our ratio of victories went up.

"If I had to fly one just for the pleasure," says McManus, "I'd fly a -38, but if I had to fight the Germans, I'd want to be in a Mustang."

Early P-38 versions had a few glitches: In high-speed dives they could become uncontrollable: "You'd get a lot of buffeting and couldn't pull out," says McManus. And with its small air intakes and complex cooling system, its engines could overheat. Later versions (there were 11 in all) featured dive flaps for better control during descents and enlargements of the intakes in the engine nacelles and at the side of the tail booms.

Although Lightnings served in every theater, the aircraft distinguished itself in the Pacific. With its long range (almost 2,600 miles in late models with drop tanks) and its ability to fly on one engine, it was perfect for a watery world of far-flung islands. Flying P-38s in the Pacific, Major Richard Bong and Major Thomas B. McGuire became the most prolific aces in World War II, with Bong scoring 40 kills and McGuire racking up 38. And on Easter Sunday, April 18, 1943, a flight of Lightnings scored a victory against the Japanese that assured the aircraft's place in legend. After U.S. cryptographers learned how to decipher coded Japanese radio transmissions, 16 P-38s ambushed two Mitsubishi Betty bombers and their escort of six Zero fighters off the Pacific island of Bougainville. Admiral Isoroku Yamamoto, architect of the attack on Pearl Harbor, was aboard one of the bombers, and Lightnings shot down both Bettys, killing Yamamoto.

And then one day they were gone—nearly 10,000 P-38s. By 1945 the first jets were taking wing; in 1947 Chuck Yeager flew faster than the speed of sound. Lightnings, like Hellcats, B-17 Fortresses, and B-24 Liberators, were just so much scrap metal. They were blown up, melted down, and bulldozed. Bud Holecheck remembers watching row upon row of P-38s lined up for target practice at the Army's Aberdeen Proving Ground in Maryland. By 1980 there were only 25 Lightnings left, less than 10 still flyable. Today they are among the rarest objects on Earth.

All of which is why it was a little jarring to encounter *Glacier Girl* in its hangar-*cum*-museum at a tiny airport in the Appalachian town of Middlesboro, looking like it just popped off the assembly line. Every rivet was perfect, the canopy shined, the wheel wells were clean enough to lick. It was the day before the start of the 2003 Dayton Air Show, at which *Glacier Girl* would compete for the Rolls-Royce Aviation Heritage Award, and Bob Cardin and the airplane's pilot, Steve Hinton, president of the Planes of Fame museum in Chino, California, were giving *Glacier Girl* a final once-over before Hinton flew it to Dayton. "What a bird!"

said Hinton. "That's as nice as you can make an airplane." Hinton was circling the airplane while also browsing through memorabilia from its original flight and documentation of its now-famous recovery.

Nothing about it was simple. The region of Greenland where the six P-38s and two B-17s were abandoned gets prodigious amounts of snowfall that never melt. By the time Atlanta businessmen Pat Epps and Richard Taylor first went looking for the lost squadron in 1980, it was long buried. It took 12 years, 13 expeditions, nearly a million dollars, ground-penetrating radar, and a soap opera of clashing personalities to find the airplanes. The B-17s were flattened, but Harry Smith's Lightning appeared to be in remarkable condition. Constantly short of funds, Epps and Taylor joined forces with Shoffner, a Kentucky businessman, who invested $350,000 in the final expedition to bring *Glacier Girl* up. Cardin, a former helicopter pilot in Vietnam who'd called Epps looking for a job as a corporate pilot, managed the 1992 expedition that extracted the P-38—in pieces. Though the story is long and convoluted, when Epps and Taylor couldn't raise additional funds, the airplane's ownership fell to Shoffner, who asked Cardin to come to Middlesboro to oversee its restoration.

Eighteen months and $600,000. That's what Cardin thought it would take to do the job when a truck dropped off the partially disassembled airplane at Shoffner's hangar. On the plus side, Cardin had the only P-38F in the world, and for a half-century-old warbird, it was unusually complete. The glacier had preserved it all: the guns, engines, and propellers, with not a bolt or rivet missing. On the negative side, says Cardin, "every single piece of the airplane was broken. We got the plane here and found out how little we knew about P-38s. We had no idea what we were doing."

Middlesboro was hardly a center of skilled aviation mechanics—"There ain't no opera there" is the way Shoffner puts it—and progress was slow. No more than four full-time mechanics ever worked at once, and usually it was one or two. And unlike restoration projects that use large volunteer teams, only a few volunteers, like Ed White, were allowed in. A U.S. Department of Energy chemist who made the 80-mile round trip from his home in Tennessee more than 600 times, White helped with the restoration while documenting it in 3,000 photographs. "Most of the volunteers [who initially showed up] didn't have enough skill and took too much training," says Cardin. "I never would have gotten it done with them."

Virtually every piece of *Glacier Girl* was taken apart until there was nothing standing but the main wing spar. Working from a set of Lockheed plans obtained from the Smithsonian Institution, Cardin stripped to bare metal whatever

COURTESY LOST SQUADRON MUSEUM ARCHIVES (3)

could be repaired—ribs, skin, fittings—and bathed these parts in a corrosion inhibitor, then primed and painted them.

But since P-38s were so rare, replacements for the multitude of unrepairable parts were scarce. Either they had to be manufactured from scratch or unearthed in nationwide searches and complex trades. The magnesium alloy drums that operated the rudder and ailerons, for instance, were corroded beyond repair, and Cardin didn't have drawings for them. "I sweated and worried and didn't know how I would duplicate them," he says. "But then I went out to California searching for parts, and a guy had tons of odd stuff, including a set of drums. I paid $5,000 for all the parts, but I would have paid that just for those pieces."

Five of the six propeller blades were nearly perfect, but Cardin needed a sixth and didn't know where to look. In his search for tires, though, he had found four, including two with special treads for takeoffs and landings on sand and dirt—just the kind of tires once found on the P-38 now displayed at the Richard I. Bong World War II Heritage Center in Superior, Wisconsin. So Cardin traded the two tires to the museum in exchange for one of the prop blades from the Bong center's airplane. All six blades were refinished by San Antonio Propeller in Texas, and when volunteer Richard Buchanan drove to pick them up, he found them packed and ready to transport—but on a rickety trailer, their tips sticking out the back. "I was just waiting to get rear-ended and my heart was in my mouth the whole way home," says Buchanan. When he stopped at a hotel on one night, he recruited a policeman to cruise by the parking lot every hour to make sure the propellers were safe.

Glacier Girl's landing gear was packed off to B.F. Goodrich Aerospace in England, which restored it gratis. The Allison engines were shipped to JRS Enterprises in Minneapolis, Minnesota, where Bill Moja rebuilt them at cost.

As the restoration inched forward, the legend grew. The hangar was open to anyone who wanted to stop by, and eventually 50,000 people a year were coming through. "We kept saying 'Two more years, two more years,' " says Cardin. On September 6, 2000, he fired up the engines for the first time. "That was the day the airplane came alive," he says. "Until then it was just a bunch of parts."

Finally, almost 10 years after the airplane arrived in Middlesboro, it was time. *Glacier Girl* (Cardin, Shoffner, and the rest of the recovery team came up with the name as

Restorers preserved the roundel insignia that the U.S. Army Air Forces was using on the P-38's production date, a decision in keeping with the quest for authenticity (left). The 475 parts of the nose and cockpit were reconditioned piece by piece before reassembly (below). Both engines were completely rebuilt, and the guns—four .50s and a 20-mm cannon—overhauled and rendered unusable (right).

On the plus side, Cardin had the only P-38F in the world, and for a half-century-old warbird, it was unusually complete. The glacier had preserved it all: the guns, engines, and propellers, with not a bolt or rivet missing. On the negative side, says Cardin, "every single piece of the airplane was broken. We got the plane here and found out how little we knew about P-38s. We had no idea what we were doing."

they drank a bottle of Scotch in celebration of extracting the P-38 on August 1, 1992) was finished, restored with 80 percent of its original parts, at a cost of some $4 million. Shoffner, a former U.S. Air Force F-89 pilot with 5,000 hours in 15 kinds of aircraft, had loved P-38s since he was a kid, and he'd long dreamed of flying *Glacier Girl*. But the airplane's insurers would approve only Planes of Fame's Steve Hinton as pilot; Hinton has logged 10,000 hours in a plethora of aircraft, including 300 hours in P-38s. On October 26, 2002, Hinton, a lanky, loose-limbed 51-year-old, ran the engines up, checked the landing gear, tightened a few fittings, and just like that, with nary a high-speed taxi test, roared into the skies over Middlesboro. Perhaps even more remarkable, 25,000 people from around the country, double the entire town's population, showed up, clapping and cheering as Hinton winged over the tiny airport.

But that flight, and a brief appearance at the Salute to Veterans airshow in Columbia, Missouri, were merely dress rehearsals for the debut at Dayton. In preparation for his hour-long flight there, Hinton eyed *Glacier Girl* closely. He checked the nose wheel's shimmy dampener and main strut extensions for leaking fluids, examined the prop governor, and waggled the flight control surfaces—"just the usual preflight stuff," he says. But every few moments he paused and simply admired the airplane. "These Lightnings have so many great stories and they're so unique-looking," he says. "When they were first made, they looked like they were from outer space, and they mesmerized people. They sound unique too: muffled and smooth instead of growling. Just look at it. It's pure Lockheed. Every surface is shapely and twisting and complicated. Look at the wheel doors. The hinges are curved and complex, full of bushings and cotter pins and washers and bolts, all to make the doors swing out and away. It's an engineering marvel, and you won't see anything like that on a foreign airplane at all."

BELOW: CHARLES STITES; RIGHT: CAROLINE SHEEN

The V-12 emitted a smooth, powerful purr, not the throaty belching of radial air-cooled engines. Moments later, the right engine fired up, and as Hinton revved both engines, the 60-year-old machine bounced and strained against its chocks.

The Middlesboro, Kentucky hangar that housed the restoration now serves as a museum for the craft and headquarters for the project staff (left). The group says the airplane draws up to 2,000 visitors a week, and a new museum is underway. Project honcho Bob Cardin (above, in white shirt) warmed up admirers at Dayton, Ohio's airshow last July. Glacier Girl *took home the Rolls-Royce Aviation Heritage Trophy and the National Aviation Hall of Fame People's Choice award.*

Warbird expert Steve Hinton chats with owner J. Roy Shoffner at Dayton, where Hinton flew Glacier Girl. *Hinton also flies a J model (trailing, above), a later P-38. Cardin attributes the J's slightly slower speed to the added drag produced by the J's larger cooling area.*

By late morning, the low gray clouds clinging to the green mountains encircling the airport had dissipated. Hinton put fresh batteries in his hand-held GPS navigation aid (the only modern gear in *Glacier Girl* is the radio), and Cardin's assistant, Jeff Cupp, and volunteer Richard Buchanan slowly pushed the propellers through a couple of revolutions to work some oil through the engine. All morning, folks had been coming in from down the road and throughout the country: Bud Holecheck was here from Baltimore, Maryland, and Charles and Glenna Dillow had just ridden from Florida on their Honda Gold Wing motorcycle.

"Get some fire bottles [fire extinguishers]," snapped Cardin, as Hinton climbed into the cockpit.

"Clear on the left?" yelled Hinton.

"Clear," shouted Cardin.

The left engine's propeller spun and black smoke poured from the exhaust as the engine caught and roared to life. Hinton's description was spot-on: The V-12 emitted a smooth, powerful purr, not the throaty belching of radial air-cooled engines. Moments later, the right engine fired up, and as Hinton revved both engines, the 60-year-old machine bounced and strained against its chocks.

In its hangar, *Glacier Girl* seemed a museum piece, almost quaint. Roaring out into the sunlight, however, it was

LEFT: CAROLINE SHEEN; ABOVE: JOHN M. DIBBS/PLANE PICTURE COMPANY, INC.

a big, menacing, powerful machine, taking us back to Harry Smith's belly landing on the ice, Richard Bong's kills over the Pacific, Bud Holecheck's strafing runs over Belgium—a time when good and evil were clearly defined and the whole nation was bent to a noble task.

Hinton taxied to the end of runway, turned around, and took off, leaping into the air. He banked left, circled, and swept low at 350 mph before heading to Dayton.

Holecheck blinked back tears, wiped his eyes, and uttered a single word: "Sweet."

Despite the tens of thousands of people who have streamed through *Glacier Girl*'s hangar over the past decade, despite the television documentaries, news stories, and newspaper articles that followed the airplane's fortunes, Bob Cardin was so focused on restoring the P-38 that he hardly noticed all the attention. At Dayton, that changed. Just as he had done in Middlesboro, he was up at dawn every day, pacing around *Glacier Girl* long before the gates opened. The Rolls-Royce trophy typically goes to the airplane whose restoration has best preserved authenticity, so Cardin laid out everything, including *Glacier Girl*'s seatbelt, tool kit, a can of Harry Smith's tobacco, and his helmet—all found with the airplane deep in the glacier. He also plunked down 18 volumes of photographs documenting the restoration process. "This is the only World War II fighter flying today with its original engines and props and guns," he said, ever arguing his case as if he was still not sure anyone would notice his airplane.

By 8:30 a.m. people started to stream by under a cloudless blue sky; by nine they were a hundred deep in front of the P-38, a crowd that never thinned in four days. "Is this the one they dug out of the glacier?" a man called out.

"Wonder what this airplane thought when it first saw the light of day," yelled a boy.

Suddenly Cardin's defenses fell, and there he was, a man transformed. "Two hundred and sixty-eight feet straight down!" he sang, working the crowd like a carnival barker.

Within a few hours the Rolls-Royce judges arrived. They peered into *Glacier Girl*'s cockpit, examined the wheel wells, jotted notes on their clipboards, and whispered to one another. By Sunday, thousands of people had gazed at the P-38, Cardin's voice was hoarse, and the results were in: *Glacier Girl* had won the 2003 Rolls-Royce Aviation Heritage Trophy, as well as the National Aviation Hall of Fame People's Choice Award, voted for by the airshow crowd. Shoffner, now using a wheelchair, was delighted. "Bob had motivation and I had determination," he said, "but had I known beforehand what it would take, I probably would have been scared to death. I'd still love to fly her. Maybe some day I'll climb in and just forget to apply the brakes!"

Five months after Dayton, with *Glacier Girl* restored and flying at last, you'd think Cardin might finally retire, or at least take a vacation. Not a chance. "This fall we had over 500 people a day in the hangar, and we're working on completing a new museum next door," he says. "When it gets warm, I'm gonna fire the engines up and then we're going to do some airshows next year. I'm staying with this. There's still too much to do."

CHARLES STITES (2)

Hinton's first flight in Glacier Girl *on October 26, 2002 (above), drew some 25,000 visitors to the airport at Middlesboro (left). The aircraft, the only P-38F in the world, will fly only rarely until it is retired.*

In its hangar, *Glacier Girl* seemed a museum piece, almost quaint. Roaring out into the sunlight, however, it was a big, menacing, powerful machine, taking us back to Harry Smith's belly landing on the ice, Richard Bong's kills over the Pacific, and Bud Holecheck's strafing runs over Belgium.

THE OTHER MOON LANDINGS

A SOVIET TRIUMPH IN THE SHADOW OF APOLLO.

by Andrew Chaikin

There was a time, in the early years of the space race, when the moon seemed to be Soviet territory. The first man-made object to reach the moon was the Soviet Luna 2 probe, which struck the surface in September 1959. A month later Luna 3 gave humanity its first glimpse of the moon's far side. In February and March 1966, Luna 9 transmitted the first pictures from the lunar surface and Luna 10 orbited the moon. And in September 1968 a handful of turtles and simpler organisms aboard the Soviets' Zond 5 became the first living beings to make a circumlunar voyage. By then, planners within the USSR were hopeful that the first words spoken from the surface of the moon would be Russian.

But when a trio of U.S. astronauts orbited the moon in December 1968, that hope all but died. Apollo 8's triumph sent a shock wave through the Soviet space hierarchy, which realized that the political victory of landing the first men on the moon would soon go to the Americans. Soviet leaders wondered what to do in response. Ultimately they focused on robotic missions, which were not only easier and cheaper than piloted lunar voyages but would also give them a chance to spin their space program as a scientific venture, rather than one conducted just for the sake of Cold War competition. The Luna missions were to include an automated sample-return probe; the government ordered that effort accelerated.

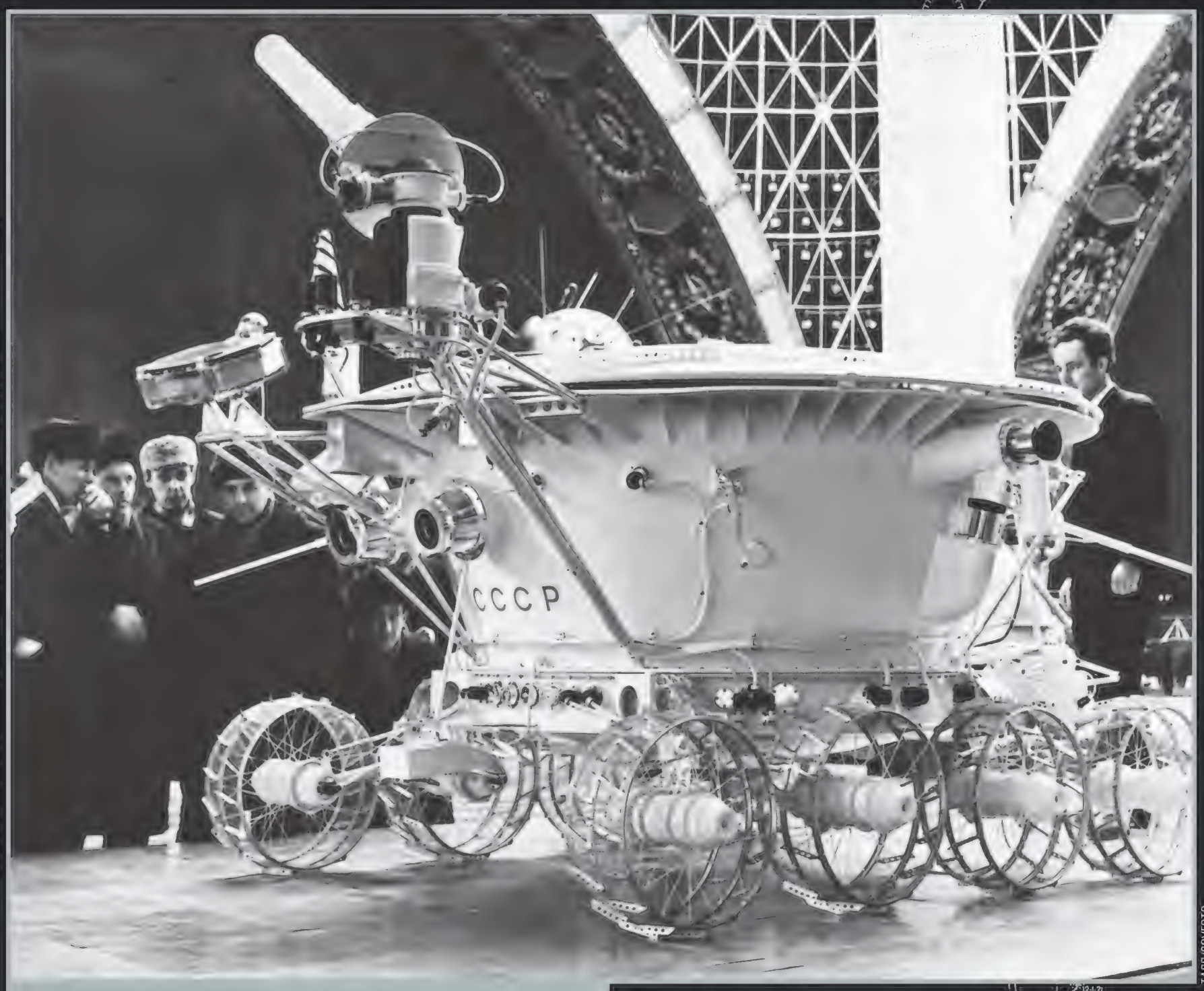
On a second attempt after a June 1969 launch failure, Luna 15 began circling the moon on July 17, 1969, two days before the Apollo 11 astronauts themselves entered lunar orbit for the first manned landing attempt. If all went according to plan, the Soviet craft could be back on Earth with a container of lunar soil a day after the astronauts returned—close enough to upstage the U.S. achievement, or, if Apollo 11 failed, to give the Soviets an outright triumph. But on July 21, as Neil Armstrong and Buzz Aldrin were preparing to lift off from the Sea of Tranquillity, Luna 15, while making its descent into the Sea of Crises, smashed into a mountain. Not until September 20, 1970, did Luna 16 alight safely on the Sea of Fertility and carry out a sample-return mission.

Luna 16 was a dazzling technical achievement, but it was also clear that, compared with America's manned lunar missions, it didn't measure up scientifically. By this time, two teams of Apollo astronauts had brought back a total of over 120 pounds of rock and dust. Luna 16's return was just 3.5 ounces. Still, geologist Alexander "Sasha" Basilevsky of the Vernadsky Institute for Geochemistry recalls that the sense of competition with the Americans was still very much alive. "These samples would be our samples," Basilevsky says. "We would study them. If you don't send anything [to the moon], you're just defeated." But Basilevsky was already looking forward to a very different kind of mission—one that would turn him into a virtual lunar explorer.

With the Soviet manned landing effort in limbo, a rover was slated to substitute for human explorers. Its name was Lunokhod, Russian for "moonwalker." The first challenge chief designer Georgiy Babakin and his team at the Lavochkin Design Institute faced was protecting their machine from the temperature extremes it would encounter on the moon. Lunokhod would have to operate in the blistering heat of the two-week lunar day, up to 240 degrees Fahrenheit, and survive the frigid two-week lunar night, when temperatures plummet to 290 degrees below zero. To control temperatures inside the rover, designers chose a tub-like pressurized shell, topped by a lid that could be opened and closed on command from Earth. The lid, which contained an array of solar cells for charging the rover's batteries, would be kept open during the day so the cells could absorb solar energy. Before sunset the lid would be closed, and the rover would go into hibernation as radioactive polonium-210 warmed vital components inside. For locomotion, designers at the All Union Science and Research Institute of Transportation tested a variety of designs for the seven-foot-long rover, including tractors, walkers, and even jumpers, but in the end chose eight individually controlled wheels, each supported by spokes and covered with wire mesh to aid mobility in powdery soil.

Once Lunokhod was on the moon, the success of the mission would be in the hands of two five-man crews chosen from the military's missile defense corps. In the spring of 1968, candidates were carefully screened for engineering expertise, capacity for prolonged mental focus and attention, quick reaction times, the ability to process information quickly, good long-term and short-term memory, and vision and hearing. So thorough was the selection process that some of the men thought they were being recruited for the cosmonaut corps, until they were told of their real mission: to operate the first wheeled vehicle on the surface of another world.

Only one member of each crew would drive the rover. Behind him would sit the crew commander, who would oversee the driver's handling of the rover. Joining them in the control room would be a navigator, a radio antenna operator, and the flight engineer, who would monitor the rover's systems. Each crew would operate the rover for two hours; then the other crew would take control. At the Lavochkin plant the crew members familiarized themselves with every aspect of the craft and



TASS/SOVFOTO

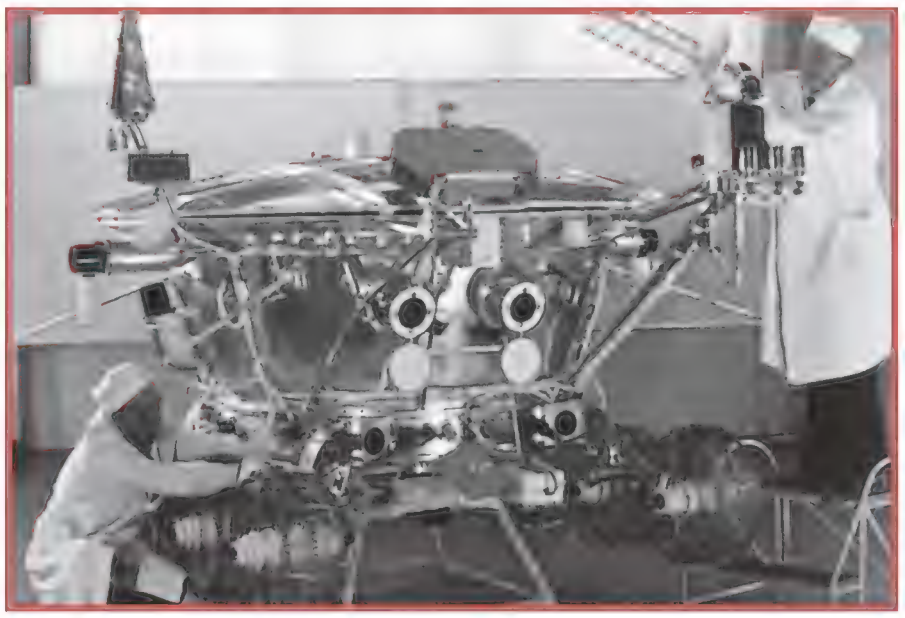
A model of Lunokhod 1 on display in the 1970s. The real rover was a source of great pride for the Soviet people.

spent hours practicing with a mockup on a specially constructed "lunodrome" near the mission's control center, in the Crimean city of Simferopol.

An exploding booster doomed the initial launch attempt in February 1969, but the second try landed Lunokhod 1 at the western edge of the moon's Sea of Rains on November 17, 1970. Under driver Gabdulkhay Latypov's control, the rover descended one of the two ramps extended from the descent stage and stood on the moon's surface, ready to begin its expedition.

Gripping in his right hand a control stick that resembled a car's gearshift, Latypov could make the rover go forward at one of two speeds (0.5 or 1.2 mph) or go in reverse. He and Vyacheslav Dovgan, the other crew's driver, turned the craft not by rotating the wheels, which were fixed, but by slowing down one side relative to the other, the way one steers a tank.

Latypov and Dovgan's only guidance came from a monitor, which displayed images from Lunokhod's two low-resolution television cameras. To any video game enthusiast it sounds simple—but this was nothing like a video game. The cameras did not send a continuous stream of images, but rather single frames, like a slide show, at intervals that varied from seven to 20 seconds. And because radio signals took three seconds to travel round trip between Earth and the moon, the driver didn't see the results of his actions for many long moments. For this reason, if crew commanders Nikolai Yeremenko and Igor Fyodorov saw Lunokhod heading toward catastrophe, they could push a button to halt the rover.



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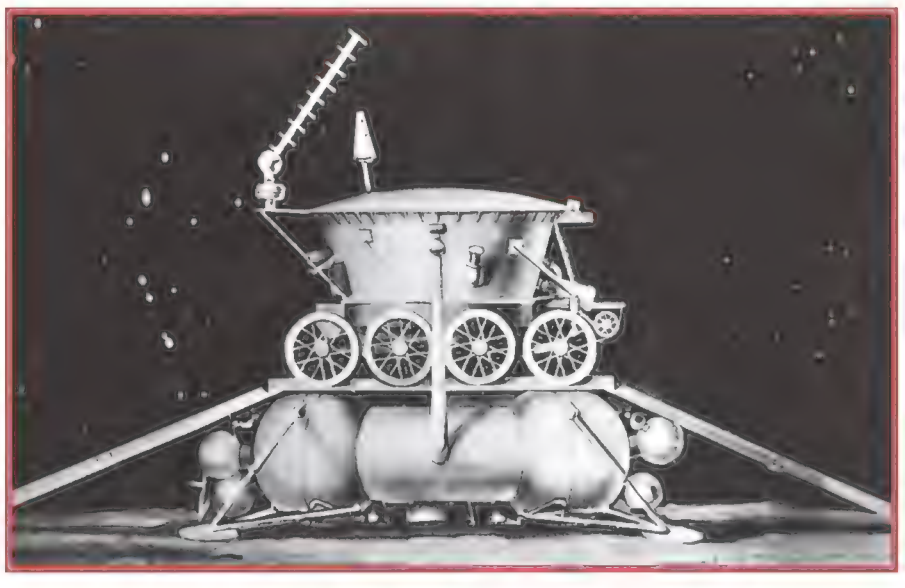


NASA HISTORY OFFICE

Top: Technicians assemble the 1,663-pound, teapot-like Lunokhod 1 rover. Bottom: Once it had finished its six-minute descent from lunar orbit, the landing module was designed to lower two sets of ramps, in case one side faced a boulder or severe drop-off.

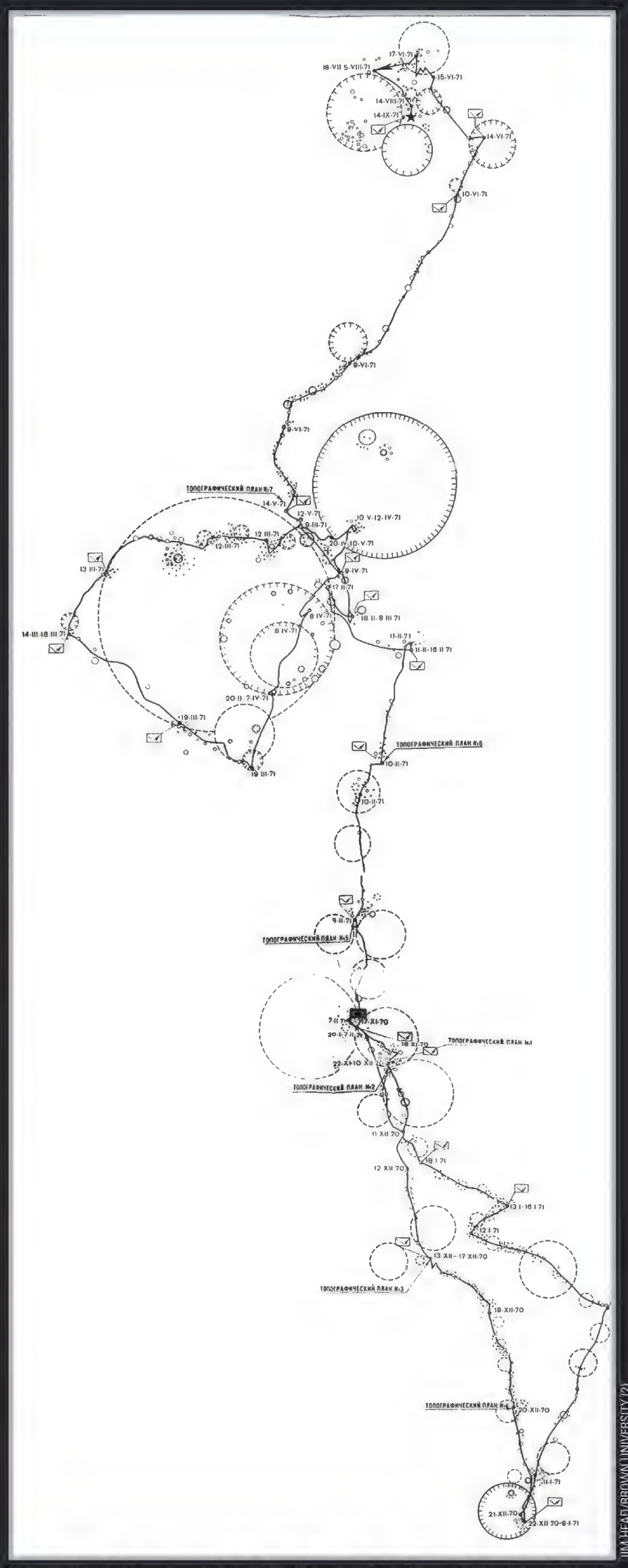
Dovgan, now 66, was well prepared by intensive training. "Driving on the moon felt even easier than it was in the lunodrome," he says, but his comment belies the difficulties of navigating the rover. The low resolution of the slide show made it difficult to spot craters and boulders, especially at high sun angles, and there was a "dead zone"—a three-foot-wide area immediately in front of the rover that Lunokhod's cameras could not see. The only solution, according to Dogvan, was to memorize the features in this area from the previous image, before the rover reached it. "When we were looking ahead and thinking of the obstacles that we did see, we also had to remember what was just behind," he says.

Dovgan also had to constantly verbalize what he saw to Fyodorov. "103," Dovgan would say, using the commander's call sign, "this is 101 reporting on the situation. Twenty degrees left of the course, a stone; distance, five meters; height, 35 [centimeters], width, 50. Straight ahead, a crater, diameter, nine meters. To the right, 15 degrees, a gap. Decision: Will turn left 60 degrees to avoid both crater and stone, and then regain the straight-ahead direction." Although Fyodorov sometimes challenged Dovgan before approving his plans, he ultimately trusted his driver's judgment as if Dovgan were actually on the moon. And indeed, Dovgan sometimes felt as if he were. "Not that I forgot that I was on Earth, but it felt like I was so phased into my work that the only thing that wasn't part of me being on the moon was the constant, continuous reporting," he recalls. "It almost felt like I was talking to myself all the time, or that I was talking to Lunokhod."

Unlike cosmonauts of the day, Dovgan and crewmates were unknown to the Soviet public and under strict orders not to talk about their work. For Dovgan, who grew up in Simferopol, the secrecy was especially tough. "I couldn't even tell my friends," he recalls. "And you know, all my friends were there; I went to school there. It was particularly hard…for me to keep my mouth shut." For Basilevsky, there was an even more frustrating problem: The control room was off-limits to him and other scientists taking part in the mission. Relegated to another room in the Crimea complex, they could listen to the crew's workmenlike dialogue only over a loudspeaker. During mission operations, the researchers were expected to be passive consumers of data, not participants in the exploration. "Scientists were considered, in the beginning, as something unnecessary," Sasha Basilevsky explains.

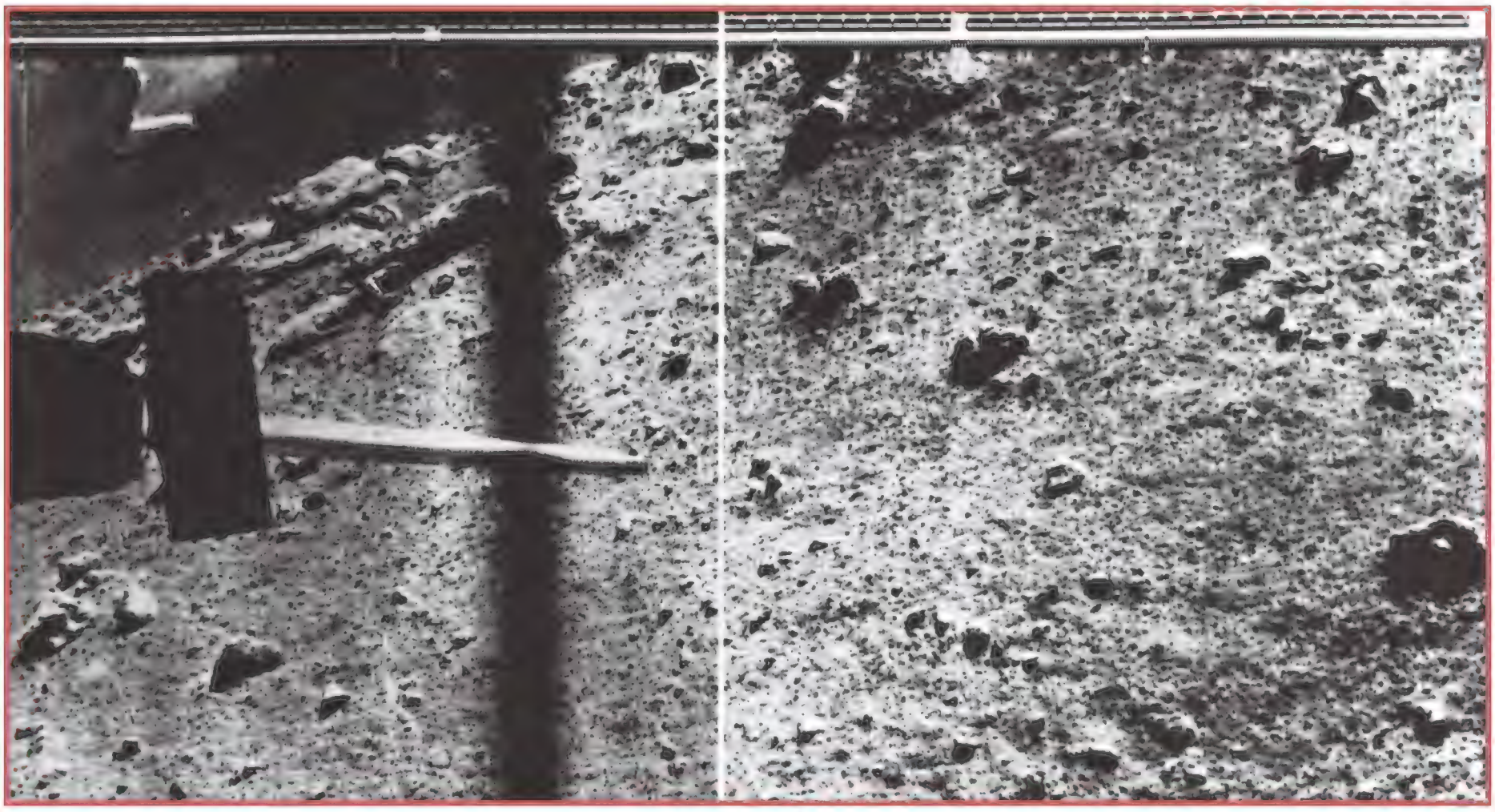
Meanwhile, on the Sea of Rains, with its Earthbound masters ever mindful of its safety, Lunokhod made halting

In an image taken by side-mounted panoramic cameras, the tracks of a Lunokhod rover's eight wire-mesh wheels appear to run through its shadow.



Lunokhod 1 roamed 6.5 miles on the Sea of Rains before its radioactive heat source ran out and its instruments froze during the two-Earth-week-long lunar night.

JIM HEAD/BROWN UNIVERSITY (2)



ALBERT ABDRAKHIMOV

Scientists used photometric targets (rectangle) painted with color squares of known intensities to identify the intensities of the materials seen in panoramas.

progress until, on November 22, having traveled some 646 feet, the rover was put to sleep for the approaching two-week night. During the hibernation, astronomers in Crimea and the French Alps bounced a laser beam off a French-built reflector mounted on the rover; these experiments were designed to provide ultra-accurate measurements of the moon's periodic wobbles, called librations, as well as the moon's distance from Earth. Some team members worried about whether Lunokhod could be revived, but after the sun had risen on the Sea of Rains, the rover was ready for its first full lunar day of work.

As the controllers gained more experience, they also gained confidence, until they were able to let the rover proceed as long as they could see no clear hazard on the monitors. Progress had to be halted for three days during the lunar noon, when the lack of shadows made driving too dangerous. Lunokhod logged almost an additional mile before night fell. And during the third workday, starting on January 17, navigators steered the rover back to its landing spot, where the landing stage stood like a tiny fortress.

It was around this time that Basilevsky ventured into the control room at last. "I came and brought a chair with me," he says. "Nobody allowed me, actually. I just did it. And I stayed. And they looked at me, and nobody said anything. The next day I came with my chair again, feeling 'I have a right to do this.' And then, it was my place."

But Basilevsky soon realized that the very things he wanted to get close to and study—large rocks—were hazards the drivers and commanders wanted to avoid. Having learned (just as the Apollo astronauts had) that distances on the moon are difficult to perceive, and wary of the time delay, Lunokhod rarely ventured closer than about seven feet from a boulder. "They were cautious people," Basilevsky says about the crews, adding that he never saw them disagree about how to proceed, or any other breach of military discipline. And, having watched the controllers during their challenging pre-mission practice runs, Basilevsky didn't try to persuade them to do otherwise.

He did challenge the crews' supervisors, who equated the mission's success with the total distance logged by the rover. The only way to obtain panoramic images with Lunokhod's high-resolution cameras was to use the craft's narrow-beam antenna, which required the rover to be stationary. At one point, Basilevsky recalls, "We could see beautiful rock fragments. I was saying to Babakin, 'Let's stop here. We'll make good panoramas; we'll see something unusual here.' His deputies told me, 'Sasha, it is Lunokhod, not Luno*stop*.' "

It was even harder for Basilevsky to use Lunokhod to obtain stereo images, one of the geologists' key tools for studying lunar landforms. The easiest way was to take a panorama, have the rover turn in place for a few degrees, then stop and take a second panorama. But for the mission managers, taking a second panorama of "the same boring place" precluded the logging of more distance, which looked good in *Pravda*, the state newspaper. To publicists, "it was a serious indicator of our success: meters, meters, meters," Basilevsky says. In his frustration, Basilevsky took one of the few stereo panoramas he had acquired and spread it out, with a special stereo viewer, on a table in the control center. He then sought out the army colonel who was responsible for the Lunokhod crew and showed him the moon in 3-D. With the desolate beauty of the Sea of Rains spread out before him, the colonel registered his amazement; "This is why," Basilevsky told him. After that, Basilevsky says he "had a green light" to request panorama shots.

Even with these occasional victories, Basilevsky and the

Anatomy of the Lunokhod 2 Rover

1. lid (to maintain internal temperature and pressure at night)

2. high-gain antenna (to communicate with Earth)

3. laser reflector (to measure the moon's movement)

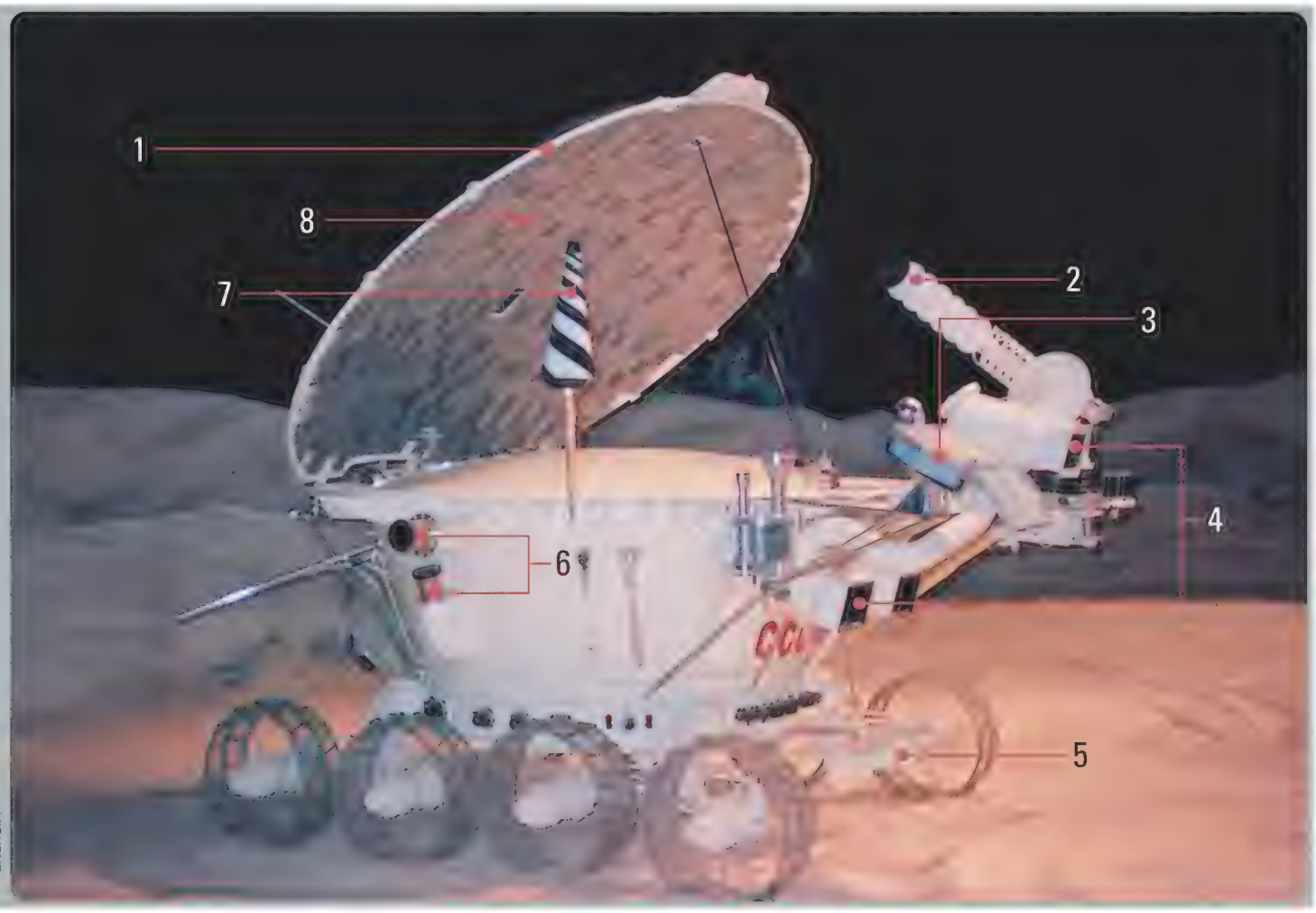
4. television cameras (to aid steering)

5. X-ray spectrometer (to analyze soil)

6. telephotometers (to take panoramas)

7. omni-directional antenna (to transmit images)

8. solar cells (to generate power)



ENERGIA

other geologists still faced battles with scientific colleagues about how best to use the rover's precious time on the moon, because Lunokhod was also constantly studying cosmic rays and X-rays and measuring the brightness of the lunar sky early and late in the lunar day. And the sheer length of the working day—a communications session with Lunokhod might last as long as 10 hours—could wear out everyone involved. The geologists could not afford the luxury of a full night's sleep either, because they needed to wake up well in advance of the next communications session to review the latest data. Only during the three-day lunar noon did the scientists get a break, with a visit to a seaside resort. During the two-week lunar night, the scientists returned to Moscow; then they headed back to the Crimea. "It was exhausting," Basilevsky says. And this went on longer than anyone expected, because instead of lasting the four months planned, Lunokhod 1 lasted almost 11 months.

TASS/SOVFOTO

In the Lunokhod control room: Igor Fyodorov (foreground) commanded navigator Konstantin Davydovskiy (left), antenna operator Nikolai Kozlitin (center), and driver Vyacheslav Dovgan (right).

But there was compensation. After one particularly grueling session, Basilevsky emerged from the control center to see the moon hanging above the horizon in the early morning sky. It was a magically disorienting sight. "When you are involved in driving, psychologically you are on the moon," he explains. "So [when I saw the moon] it was like, 'Okay, but I was there!' And it was some special moment in my life when I realized that through these devices, I *was* there. On that shining object in the sky."

In the United States, that bright, cratered world had become a place for men, not machines, to explore. As it happened, the Soviet robotic successes came as NASA was recovering from the previous April's Apollo 13 fiasco. At the same time, U.S. space budgets were in decline, forcing the cancellation of the last few Apollo landings. The Soviet robots' success fueled a debate in the U.S. on whether sending people to the moon was worth the cost and the risk when machines could do the job—or so critics claimed. That point of view never held any sway with the scientists. Apollo 11 and 12 lunar sample co-investigator Bevan French recounts: "Anyone who…said that the Luna 16 and Lunokhod missions were so successful that it meant we should have stopped doing manned lunar missions would've been laughed out of the room."

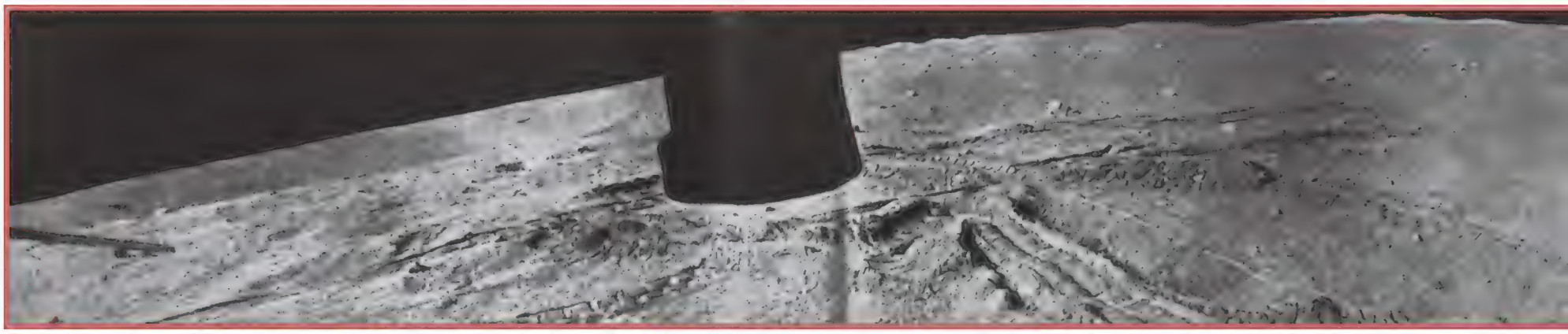
No one needed to tell Basilevsky that. "It was obvious that the science we were doing [with Lunokhod] was much less important than what was obtained by Apollo," he says. But to the Soviet people, the value of the Lunokhod and Luna robots had little to do with absolutes. In the USSR, where information about the Apollo landings was scarce, these machines were a source of enormous pride. Soviet scientists could now contribute

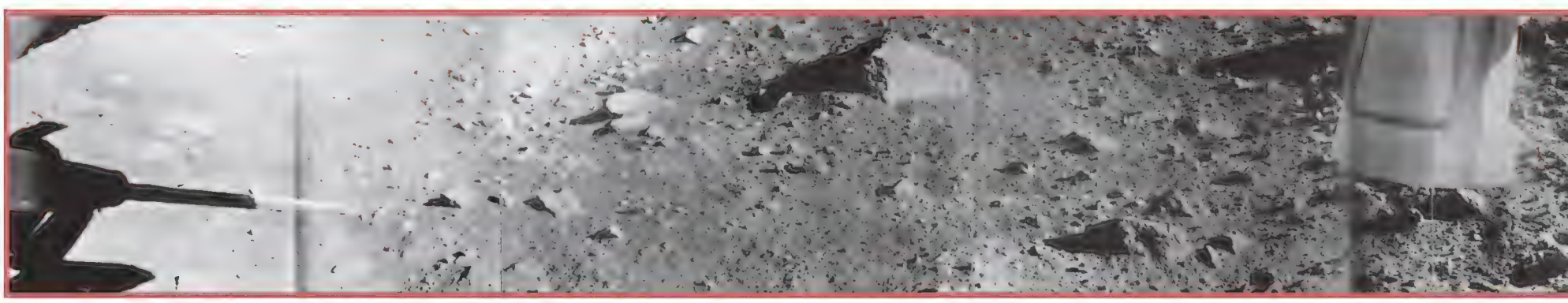
lunar samples for research instead of merely borrowing; in 1971 NASA and the Soviet Academy of Sciences agreed to each exchange three grams of returned samples.

In January 1973, a month after Apollo 17, the final U.S. moonwalk, Lunokhod 2 landed at the Sea of Serenity's eastern edge. By this time, the stature of Basilevsky and the other geologists had risen substantially—as had the confidence of the two crews—so much so that after four months on the moon Lunokhod 2 had driven more than 21 miles, three times as far as Lunokhod 1 had traveled in twice the time. (It helped that Lunokhod 2's navigation cameras were improved, and sent an image every three seconds.) Near the end of its fourth lunar day, the rover approached a long, straight valley where the geologists could see boulders and even the rarest of features on the dust-covered moon: an outcropping of bedrock. Basilevsky was ecstatic. "He kept exclaiming, 'Wonderful, this is it! Stop, look at this, show me that!' " says Dovgan.

Then, on May 9, 1973, the crew made a fatal mistake. "The sun was behind us," Basilevsky says. "In the navigation camera we saw a beautiful smooth surface." But the pictures were deceiving. All shadows were hidden behind the objects casting them—including crater walls. Before anyone realized what had happened, Lunokhod descended into a crater some 15 feet across. What the crew should have done, Basilevsky says, was to stop, close the rover's lid, then take a panorama to see where they were; instead, the controllers started maneuvering Lunokhod out of the crater. The lid touched the crater wall, resulting in part of the solar cells being covered with soil. "We immediately felt it, because the electric current dropped," Basilevsky says. Within an hour of entering the crater, Lunokhod had re-emerged, and all seemed well—until everyone realized what would happen as night approached. The rover's lid would have to be closed to keep it from freezing during the night. When the team closed the lid, they dumped lunar grime on the radiator, which was supposed to get rid of excess heat during the day. "We put on this radiator the best insulator—lunar soil," Basilevsky laments.

With the arrival of a new day, the lid was opened, and soon afterward, as the rover began its work, sensors showed the temperature aboard Lunokhod 2 increasing. Everyone knew it was only a matter of time before the rover would die. Before that happened, Basilevsky realized, Lunokhod could make a risky but potentially rewarding venture to some nearby, geologically intriguing mountains. He told the controllers, "Go to that place; we will die like heroes. If we just go stupidly in some safe direction, we will die anyway."





The nearly 300 panoramas transmitted during the two missions were produced by telephotometers mounted on the sides of the rovers. Panoramas were of higher quality than television images and were used to navigate. Scientists used vertically oriented telephotometers (seen protruding into images) to capture zenith-to-nadir panoramas. Then, by calculating the sun's apparent position, crew members could calibrate the rovers' gyroscopes. At the periphery are the rovers' rod-like backups for more sophisticated antennas.

JIM HEAD/BROWN UNIVERSITY (3)

But mission managers were unwilling to risk it, and once the temperatures aboard Lunokhod climbed above 150 degrees Fahrenheit, Basilevsky says, "That was the end."

A third Lunokhod was planned, and there was talk of a mission more ambitious and potentially much more rewarding than Lunokhod. Named Sparka, from the Russian word for "pair," the mission would team a Lunokhod-style rover with a Luna sample-return craft. Roaming the moon, the Sparka rover would pick up samples with a robotic arm,

take pictures, and carry its geologic treasures to a waiting sample-return vehicle. With a well-chosen, well-documented collection of samples, Sparka promised a scientific return equalling that of the Apollo landings.

It was not to be. Support for more robotic missions to the moon evaporated as interest shifted to a more distant and mysterious goal: Mars. Already, the Soviets had tried two times to land instruments on the Red Planet without success, and it was public knowledge that the United States was planning its own Mars landings, in a program called Viking. Lunokhod 3 never went to the moon—the rover now sits on display at the Lavochkin Museum in Moscow—and Sparka never made it past the conceptual stage. Meanwhile, the giant N-1 booster, designed to put humans on the lunar surface, had exploded in four separate test launches, effectively dooming any hope of a Soviet manned landing.

Like so much about the Soviet space program, many details about the robotic lunar missions remained secret for decades. Lunokhod's crews were not publicly acknowledged for their work until 1990, and today, Lunokhod's forgotten images seem like postcards from a parallel history just coming to light. Basilevsky and his colleagues had a bittersweet flash of recognition in 1997, when NASA's Pathfinder Lander delivered a diminutive rover called Sojourner to Mars. Although Sojourner did most of its exploring within about 35 feet of its lander, Dovgan and his fellow controllers were so impressed that they wrote a letter of admiration to NASA (which, according to Dovgan, the agency did not answer).

Among the creators of Pathfinder and Sojourner, the reviews of Lunokhod are mixed. According to Don Bickler of NASA's Jet Propulsion Laboratory in Pasadena, California, one of the engineers who directed Sojourner's design, technology has changed so much since the early 1970s that the Mars rover bore little resemblance to its lunar predecessor. Bickler says that during his work on Sojourner he briefly studied the Lunokhod design, but he wasn't influenced by it. "There was nothing we could use there," he says flatly.

Down the hall from Bickler, Tom Rivellini offers a kinder perspective. Rivellini, who helped create the airbags that got Pathfinder and Sojourner safely to the Martian surface, is now working on a proposed robotic mission to retrieve samples from the moon's south polar region. He says of the Soviet missions, "When you go back and look at this stuff, it's impressive.... They were inventing the wheel; nobody had done this." Rivellini points out that unlike the Soviets, whose big Proton boosters could carry heavy payloads, he and his colleagues have to design for smaller launchers, a limitation that can make spacecraft design and production more difficult and expensive. Still, Rivellini says, future robotic explorers that roam the planets will owe a debt to Lunokhod. "Personally, the way I view the work the Soviets did back in those days is as a proof of concept that it could be done," Rivellini says.

It's an attitude Dovgan would appreciate. He still looks back on the Lunokhod missions with pride, and is grateful he was a part of them. Whatever worlds rovers might someday explore, his favorite destination is still the one he got to know so intimately three decades ago. "The moon is special," he says. "She's such a beauty. I come outside sometimes and look at it. And it seems to me sometimes that it winks at me."

Comment

The Need for Speed | Ron Swanda

I can't imagine a more humbling end for an aviation legend.

Late last November, the national TV news shows all carried footage of a Concorde supersonic transport being barged slowly up New York's Hudson River to the Intrepid Sea-Air-Space Museum in Hudson River Park.

The image of the airplane, perched atop the barge like a wounded stork, still proudly holding its head high for all the media's cameras and crowds of onlookers, will be forever in my memory.

For many years I marveled as the Concordes swooped to a landing at Washington Dulles International Airport in northern Virginia. I was thrilled not only by the grace of their approach but by what they symbolized about the future of civil air transportation—a future defined by speed. With the retirement of the Concorde, was that future invalid? Did the Concorde's demise indicate that air travelers don't value speed and time?

This issue was addressed at a recent workshop on the future of supersonic flight sponsored by the Federal Aviation Administration. Richard Smith, executive vice president of Netjets, an organization that sells shares of business jets, recounted that fractional owners of aircraft sometimes find that their airplanes are not available when they want them because they are already in use by another owner. In such a situation, Netjets, like all fractional providers, will offer the owner an upgrade to another aircraft.

Smith noted that when owners of the fastest business jet available today, the Cessna Citation X, which cruises at Mach .92, need a substitute airplane, they are not interested in upgrading to a larger airplane; they want one equally fast. Their need is speed. There was no doubt in Smith's mind that a supersonic business jet would have buyers, and Netjets would surely be one of them.

Business jet manufacturers have been exploring the idea of a supersonic business jet for many years, but they realized that for customers to take full advantage of it, the craft would need to be able to fly supersonic over the world's landmasses, not just its oceans. The Concorde was not permitted to fly supersonic over the continental United States because federal regulations forbade it.

Currently, Part 91 of the Federal Aviation Regulations prohibits all civil aircraft operation at speeds greater than Mach 1 over the United States and imposes flight limitations to ensure that civil supersonic flights entering or leaving the country will not cause a sonic boom that could reach the surface of the landmass of the United States. Even if a supersonic aircraft slows to subsonic speed, its sonic boom plows on ahead of it, so this rule creates a buffer zone offshore.

In 1990, the Federal Aviation Administration proposed to amend the noise standards and operating rules for future civil supersonic airplanes. After analyzing the comments that this proposal received, the FAA determined that further investigation and research was necessary before a final rule could be developed. Specific noise standards have therefore not been established yet for future civil supersonic airplanes. The FAA anticipates that future proposed standards will require that an airplane's noise impact on a community not exceed that of a civil subsonic airplane certified to the most restrictive current noise levels. Is this feasible?

It may be. In 1999, NASA efforts to develop technologies for a supersonic large transport were terminated after all the manufacturers involved cited the high cost of development and what were anticipated to be stringent federal regulations regarding noise and emissions.

In 2000, the National Research Council conducted a study to identify breakthrough technologies for overcoming key barriers to the development of a commercial supersonic aircraft that would be both environmentally acceptable and economically viable. The study, "Commercial Supersonic Technology, The Way Ahead," concluded that none of the anticipated obstacles to commercial supersonic aircraft are insurmountable. It went on to note that while NASA should have its eye on supersonic commercial transport, research was also needed to determine the impact of sonic booms produced by smaller supersonic business jets.

The Quiet Supersonic Platform (QSP) program, sponsored by the Defense Advanced Research Projects Agency, began in 2000 and is a Congressionally mandated effort to develop technologies that could reduce the impact of a sonic boom to 0.3-pound-per-square-foot pressure propagated to the ground by the shock wave. This is significantly less than the 2.0 pounds per square

OVERVIEW: QUIET SUPERSONIC JET

Initial Gulfstream QSJ Design Requirements	
NBAA IFR Range	4,800 nm
Cruise Mach	1.6–2.0
Max. Ramp Weight	100,000 lb
Design Payload	1,600 lb
Cabin Size	1,300 cu ft (G-II size)
Takeoff Field Length	6,500 ft
(sea level; int'l. standard atmosphere + 20°C)	
Civil Certification	FAR 25 (or similar)

Environmental Issues	
Boom Overpressure:	
Acceptable for Overland Supersonic Flight	
Takeoff Emissions:	ICAO with Margin
Cruise Emissions:	Minimum Impact
Airport Noise:	Stage 4
Mission Readiness	>0.99 percent
Engine Life (STBO)	≥2,000 hr
Civil Market Price	$70–100 million

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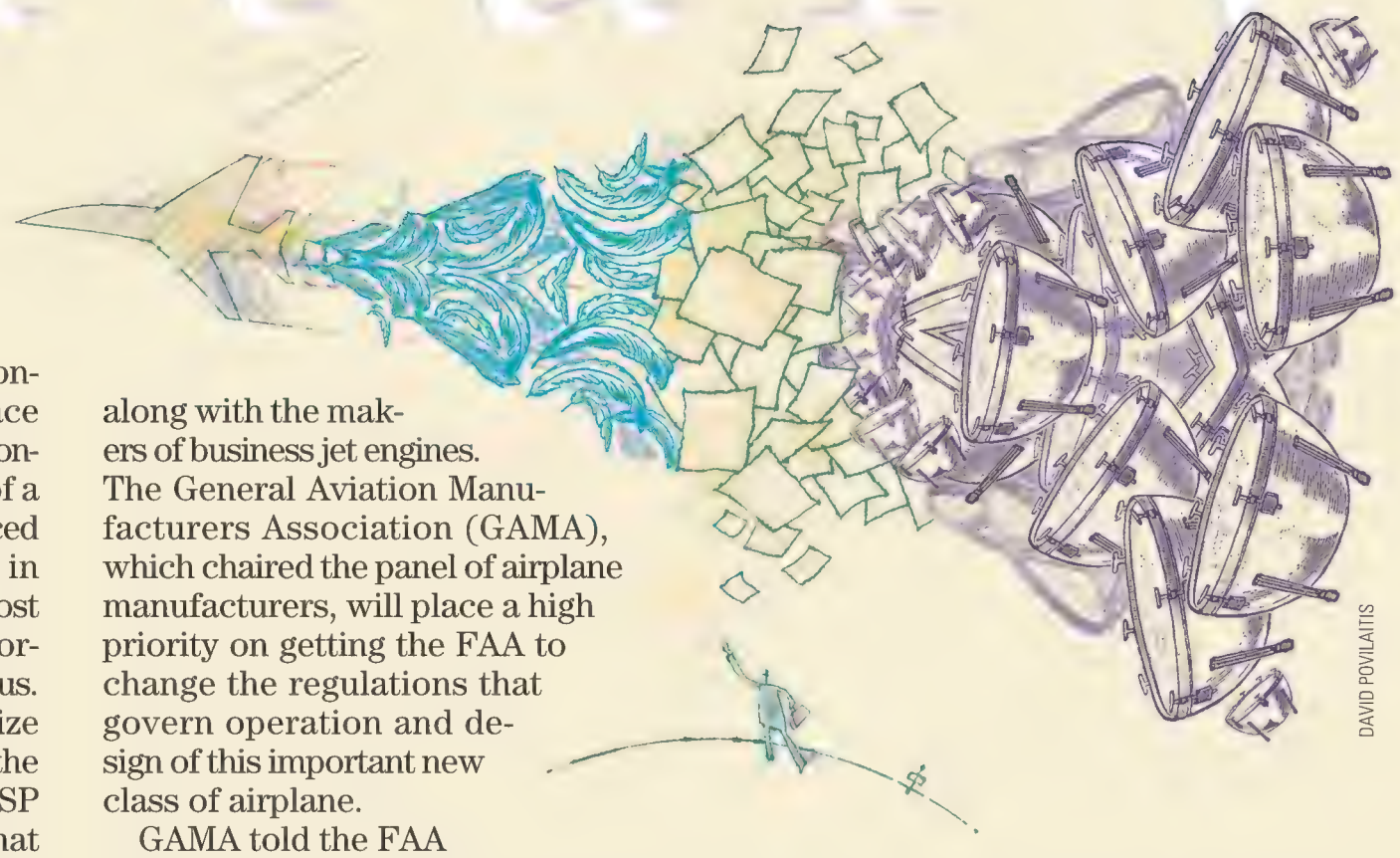


DAVID POVILAITIS

foot created by the Concorde, an impact that restricted it from flying at supersonic speeds over land.

Last year, the QSP Program, in conjunction with Gulfstream Aerospace and Raytheon Aircraft Company, demonstrated that aerodynamic shaping of a modified Northrop F-5E fighter reduced the craft's sonic boom signature in flight. The modification consisted, most visibly, of an enlargement to the forward fuselage to make it more bulbous. The test also confirmed that the size of the aircraft has a direct effect on the noise heard on the ground. The QSP demonstration was a success in that it indicated that by simply altering the shape of the fuselage and other aerodynamic elements, designers can dramatically reduce the noise produced when an aircraft exceeds Mach 1.

Even without advanced shapes, the smaller the airplane, the smaller the sonic boom it will create. In fact, the overpressure produced by advanced designs may not be described accurately by the term "sonic boom." Those familiar with the QSP demonstration flights suggest that "sonic whoosh" or "sonic poof" may more accurately convey the sound. Therefore the development of a quiet supersonic business jet is not only feasible, it is likely.

In light of this research, and because the FAA's rules had not been re-examined for more than two decades, last November the agency requested public comment on the issue and sponsored a workshop on supersonic flight. Gulfstream Aerospace, long interested in developing a supersonic business jet, submitted substantial details for what it calls a Quiet Supersonic Jet. The initial design requirements for the QSJ are presented in the sidebar (opposite).

At the FAA workshop, Gulfstream Aerospace was the most vocal company among the participants, but all manufacturers of business jets attended, along with the makers of business jet engines. The General Aviation Manufacturers Association (GAMA), which chaired the panel of airplane manufacturers, will place a high priority on getting the FAA to change the regulations that govern operation and design of this important new class of airplane.

GAMA told the FAA that it is essential to begin immediately the process of changing the regulations that prohibit supersonic flight. Since these rules were established in the 1970s, technologies have advanced significantly, and recent studies have shown that safe and environmentally acceptable designs for aircraft and engines are not only possible but likely to have sufficient market demand. The first new supersonic airplanes are likely to be advanced general aviation aircraft—business jets.

GAMA also noted that it is essential that the FAA maintain sufficient research and development activities to support this rulemaking process. And as most supersonic civil operations will involve international flight, the FAA should also begin negotiations with its counterpart agencies in other nations to revise international standards and recommended practices to allow advanced supersonic aircraft to operate internationally.

In November 2002 the Commission on the Future of the United States Aerospace Industry issued a report stating, "Superior mobility afforded by air transportation is a huge national asset and competitive advantage for the United States. Because of the tremendous benefits derived from a highly mobile citizenry and rapid cargo transport, the United States must make consistent and significant improvements to our air transportation system a national priority."

Because they have already done some preliminary work and because they serve a market that needs and can afford supersonic aircraft, business jet makers are uniquely positioned to create one such improvement: the next generation of high-speed transport. No company can make that move, though, under the current FAA regulations.

In order to ensure that new vehicle technologies are introduced into service efficiently and safely, the FAA's regulations must keep pace with the technologies that are both here and near. They must enable—not restrict—improved safety and mobility.

When I look at the Wright brothers' 1903 *Flyer*, I see a beginning, not an end. And when I look at the Concordes that are now being placed in museums, I'd like to think of them in the same way.

Ron Swanda is vice president for operations at the General Aviation Manufacturers Association.

The years between the two world wars made for a particularly fertile period of aviation history, filled with invention and record-setting flights, yet few people ever set foot in an airplane. Still, the public was curious about flying, and magazine publishers responded with such titles as *Flight*, *The Slipstream*, and *Airways*. Most of the publications were heavily supported by industry advertisements. Magazine covers served as advertisements too, pitching the idea that flying was liberating and glamorous. Of these, the covers that best express the spirit of aviation's Golden Age were those of *Popular Aviation*, a Chicago, Illinois monthly. Its covers convey not just the speed of flight but the freedom from Earthly concerns that only the airplane could afford.

by Dinne Ledeen

Reflecting *the* glow *of* flight's golden age

Aviation magazines of the 1920s and '30s mirrored the promise of an era.

POPULAR AVIATION and Aeronautics

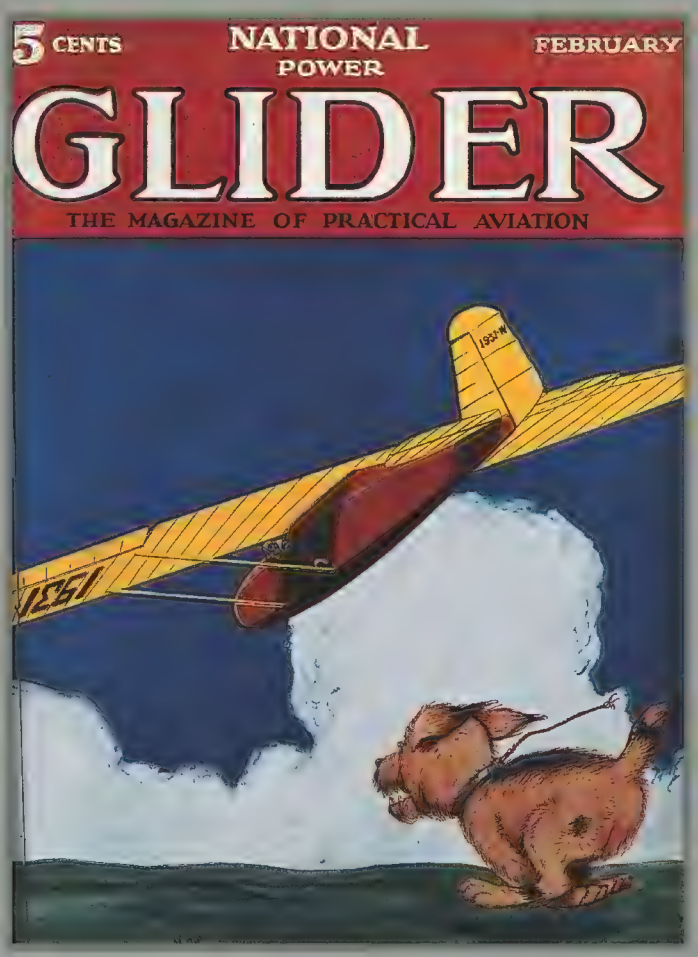
FEBRUARY 1929 ✕ PRICE 25 CENTS

ALL MAGAZINE COVERS COURTESY NASM LIBRARY

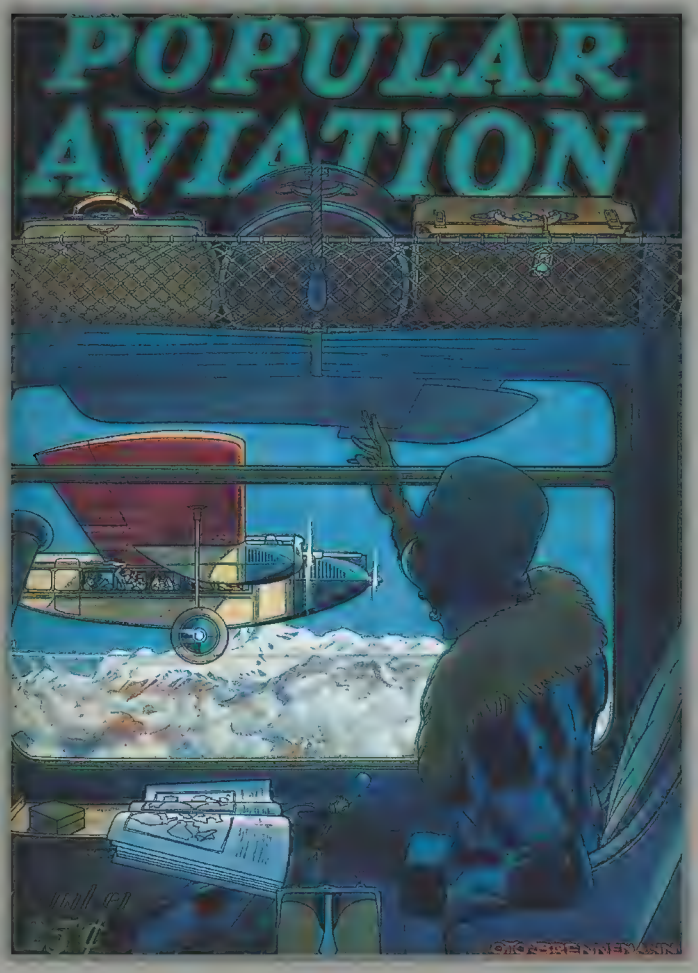

Aeronautics
MAY

Aeronautics, May 1930. This single-engine monoplane is similar in design to the *Spirit of St. Louis*, the Ryan aircraft that Charles Lindbergh flew from New York to Paris in 1927. In the aftermath of Lindbergh's historic flight—the first solo, nonstop aerial crossing of the Atlantic—aviation industry stocks rose and interest in flying soared. People began to accept the idea that airplanes were safe, though Lindbergh's steady 33.5-hour flight across the Atlantic was nothing like the bold aerobatics portrayed on this modernist cover.

Popular Aviation, July 1932. An airplane evocative of a Granville Gee Bee puts on a dazzling aerobatic display. The Gee Bee's fame, though, came from its success as a brutish little racer; flying a Gee Bee Z, Lowell Bayles won the 1931 National Air Race Thompson Trophy in Cleveland, Ohio, and Jimmy Doolittle scored a victory the next year in a Gee Bee R-1. Built purely for speed, the Gee Bee was dangerously difficult to control. Three months after his win, Bayles died when his Gee Bee crashed during his attempt to set a world speed record.



National Power Glider, February 1931. In his monthly column, Editor E. Stieri informed readers that his publication had "pledged itself to give to the youth of America first hand authoritative and instructive information on this, the fastest growing industry in the world, Aviation." Stieri's expectation of a youthful audience finds expression in his cover choice.



Popular Aviation, November 1928. Three-engine, or tri-motor, transport airplanes, such as those manufactured by Ford and Fokker, helped equip the fledgling airline industry of the late 1920s. Early airline travelers flew in unpressurized cabins and experienced deafening noise, bumpy rides, and, frequently, airsickness. The passengers of the two aircraft depicted in this cover seem untroubled by such discomforts, though in reality, they would have fainted from hypoxia, flying as they were in the thin air above snow-covered mountains.

Popular Flying, January 1933. Editor W.E. Johns had a strong interest in World War I aviation history, as evidenced by this cover, which portrays an engagement between British and German fighters.

Flight, July 10, 1931. London-based Palmer Tyre Limited frequently advertised its wares on the cover of *Flight*, a journal that described itself as "devoted to the interests, practice, and progress of aerial locomotion."

Popular Aviation, August 1928. The aircraft depicted on this cover bears a striking resemblance to the Dornier Do.J Wal (whale), a 10-passenger, twin-engine flying boat with a 74-foot wingspan. In 1927 the German airline Deutsche Luft Hansa (now Lufthansa) began using Wals to transport travelers across the Atlantic to Brazil. By the early 1930s, Wals had made more than 300 Atlantic crossings at a then-swift average speed of 87 mph.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FIRST IN A SERIES

The People and Planes of SANTA PAULA

Flanked by the Santa Clara River, Santa Paula Airport is home for dozens of vintage aircraft, including this de Havilland Tiger Moth, flown by owner Dave Watson.

Antique airplanes and their fans thrive at this California airport.

by Marshall Lumsden ★ Photographs by Peter McBride

"Down there on the right: That's where my grandfather's airstrip was," says Bruce Dickenson, banking sharply. Under the right wing of *White Bear*, a 59-year-old Howard DGA 15 monoplane, we spot a small sandy rectangle cut out of the underbrush. No traces of a landing area remain.

Directly beneath us the Santa Clara River meanders through its valley, and on both sides commercial groves and pastures blanket the sloping southern California landscape. Three miles straight ahead, the valley narrows where the river, a freeway, and the town of Santa Paula come together. Between the river and the highway is runway 22 of Santa Paula Airport, one of the most enduring and colorful of America's old-time, small-town airfields. But Santa Paula Airport was actually born here, upriver—out of a catastrophe and one man's desire to fly.

Dickenson's grandfather, Ralph Dickenson, was a prosperous rancher with land along the river bank. Like most of the country, he was inspired by Charles Lindbergh's 1927 transatlantic flight, so he joined like-minded local farmers to form an aeronautics club. Ralph traveled 50 miles to Los Angeles to take flying lessons from a former World War I ace named Hal Rouse. After eight hours of instruction, he bought an International biplane and brought it back to his ranch, where he had carved out an airstrip and built a hangar. Soon, several other farmers bought airplanes and used his airstrip.

Danny Brucker, who owns a hangar at Santa Paula, has a white-walled good time in his vintage roadster, emblazoned with the logo of the Gilmore Oil Company, which in 1930 donated oil for paving the runways.

On March 12, 1928, just before midnight, the St. Francis dam, 40 miles to the northeast, collapsed. A full reservoir released a huge wall of water. Mud and debris swept down the Santa Clara River valley, destroying everything in its path and killing at least 500 people. The flood swallowed up Ralph Dickenson's airstrip, taking his hangar and the biplane with it. Afterward, he found the hangar half a mile downstream, the aircraft still inside, only lightly damaged.

The club members now regarded the building of a new airport with some urgency, and Ralph

On the first Sunday of each month, hangar owners open their doors to the public. Right: Pat Quinn, wife Arlyss (left), and friend Geraldine Deason offer refreshments to those interested in inspecting Quinn's Beech Debonair and yellow Bücker Jungmann. Below: Santa Paula rewards aviators with classic southern California beauty.

Dickenson agreed to raise money for it. With $1,000 each from 19 investors, he formed the Santa Paula Airport Association and purchased a tract of flood-damaged land just south of Harvard Boulevard in the town of Santa Paula. Volunteers did most of the preparation, working day and night. Farmers brought tractors to grade the land. Dirt for fill was donated by local packing houses. Two companies provided oil to surface the landing strip, which was 1,530 feet long at completion. Cash donations were used to pay kids to pull weeds, clear rocks, and stomp gopher holes—50 cents a day or a free airplane ride.

The dedication took place August 8 and 9, 1930. The airport's eight hangars, including three that were salvaged from the flooded Dickenson ranch, were draped with patriotic bunting. Six thousand spectators turned out to watch glider flights, parachute jumps, and air races. The high school band played. Local aviator Edith Bond and movie stunt pilot Garland Lincoln thrilled the crowd with flying stunts.

Today you can get a glimpse of this opening day in the flickering, grainy images of old black-and-white movies when you visit one of the hangars of the Aviation Museum of Santa Paula. There's dapper racing pilot Roscoe Turner and a closeup of his pet lion cub, Gilmore, caught blinking at the camera; a grinning Pancho Barnes in boots and jodhpurs, proprietress of the Mojave desert's Happy Bottom Riding Club; and an early Goodyear blimp sailing overhead. All in all, a very big day for a small airport.

BELOW: CAROLINE SHEEN

Bruce Dickenson's late father, Don, purchased *White Bear*, the 1944 Howard, in 1954. "I sat in this seat when I was 16 years old," Bruce tells me, adding, "and I threw up over there when I was four." A disembodied voice on the radio announces its position in the traffic pattern on the downwind leg, parallel to the runway. We spot a Cessna below at 600 feet, scooting along against the backdrop of South Mountain, which looms to our left. "He's a foreigner," Bruce observes. "We don't like to get that close to the airport, but they're afraid of that mountain, I guess."

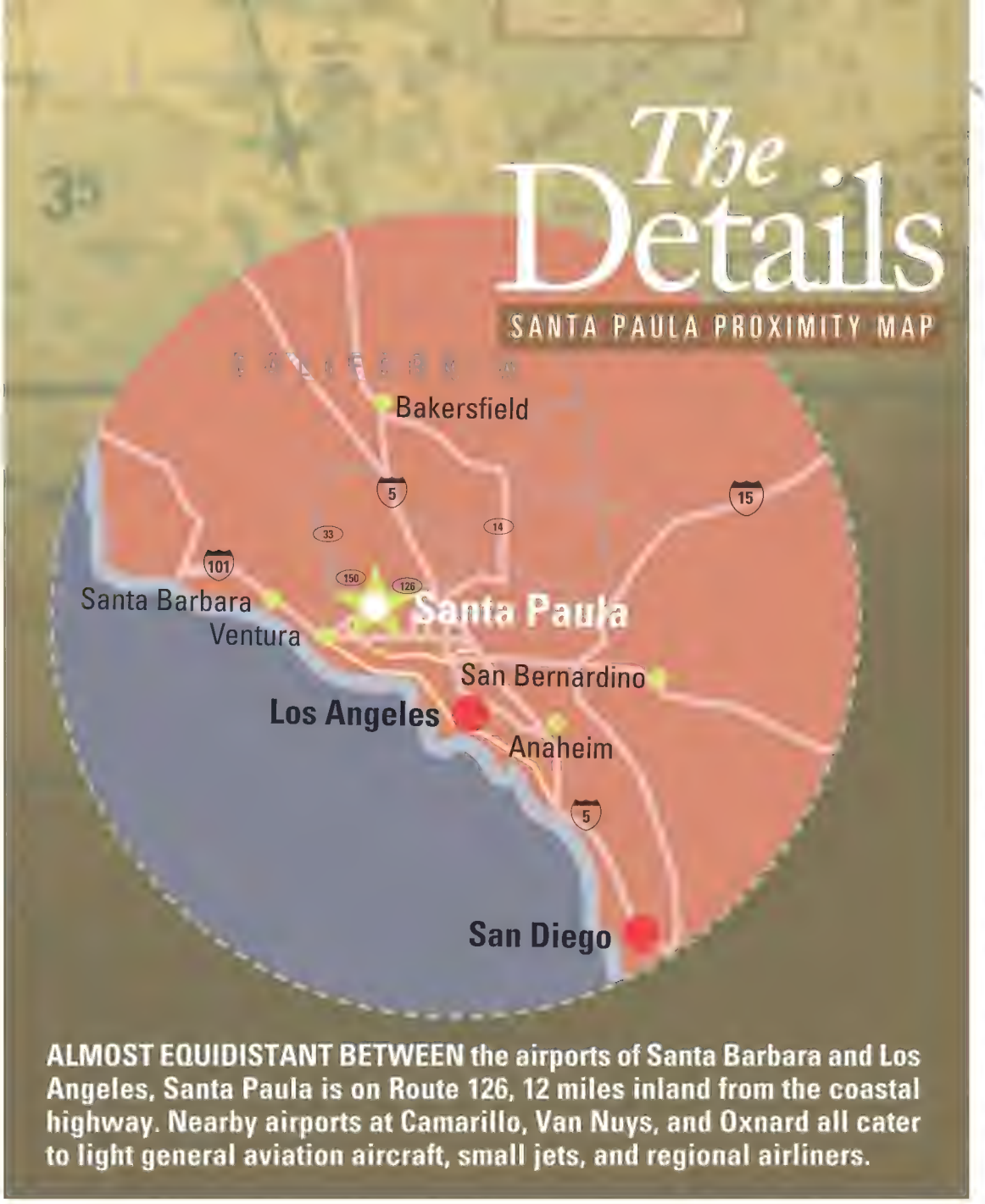
Below are the angled rows of hangars. The original eight have grown to 109, and at present Santa Paula is home to about 300 aircraft. Still, it is very much Ralph Dickenson's airport, and almost everybody likes it that way. No corporate jets are going to intrude here because the runway will probably never be longer than the current 2,650 feet. There are no runway lights, no air traffic control tower, and no beacon. Aircraft tie-down fees are $25 a month, and hangars can be purchased only by licensed pilots with flyable aircraft. The only paid employees have been part-time bookkeepers; the airport managers, almost without exception, have been volunteers.

The best time to visit Santa Paula is on the first Sunday of the month. Visitors are welcome at any time, but on first Sundays owners open up hangar doors and wheel out their aircraft in order to take advantage of a California law exempting antique airplanes (those at least 35 years old) from a personal property tax if they are publicly displayed at least 12 days a year. Since 1988, "First Sunday at Santa Paula" has turned into a festive tradition, drawing aviation lovers—and their kids—to wander along the rows of hangars and watch pretty little airplanes take off and land.

Start a visit at the museum's main hangar, filled with an eclectic display of photographs, posters, old newspaper headlines about the airport dedication, aircraft models, and a restored Stinson Reliant. Chances are you'll run into museum president Bob Phelps. In 1937, he was working as a lineboy at an airport about 75 miles east of Santa Paula, washing and servicing aircraft in exchange for flying time. One day he flew to Santa Paula Airport with his boss, Jim Dewey. "I was amazed," he recalls. "I had never been out of my local area, and here were all these mountains around and the river. And the airport was just a gravel strip at the time."

In 1940, Phelps accompanied Dewey to nearby Oxnard Airport to start a civilian pilot training school, and later they moved their operations to Santa Paula. On Sunday, December 7, 1941, Phelps returned from a flight to hear of the Japanese attack on Pearl Harbor. To discourage further attacks by the Japanese, airports in the coastal defense zone not essential to training military pilots were closed. "Within three months, this airport was shut down," recalls

The Details



ALMOST EQUIDISTANT BETWEEN the airports of Santa Barbara and Los Angeles, Santa Paula is on Route 126, 12 miles inland from the coastal highway. Nearby airports at Camarillo, Van Nuys, and Oxnard all cater to light general aviation aircraft, small jets, and regional airliners.

CAROLINE SHEEN

Vintage transportation of all varieties interests the people of Santa Paula. The First Sunday open houses often feature antique car shows.

Bruce Dickenson, grandson of airport founder Ralph Dickenson, is building an airplane of his own design.

Phelps. "They closed all the hangars and padlocked them, then disabled all the airplanes in the hangars." Santa Paula Airport would not reopen until 1945. Meanwhile, airport founder Ralph Dickenson became a civilian instructor at Oxnard, training military pilots.

Bob Phelps ferried some of the airplanes from his flight school inland to the desert town of Baker, California, then went to work as an inspector with the Civil Aeronautics Administration (forerunner of the Federal Aviation Administration). Soon he joined the U.S. Army Air Corps, flew transports in the Far East, and after two years came back to a career in the CAA. He often returned to Santa Paula, and in 1981 he retired, moved there for good, and helped start the museum.

"People used to come to the airport and ask, 'Where's your museum?' " says Phelps. "Our answer was, 'We don't have a museum in itself, but the entire airport is a museum,' which it was. We got tired of the question, though, so myself, Bruce Dickenson and his wife Janice, and an attorney decided we would make a museum."

"People say this is a little airport," says Doug Dullenkopf, owner of Screaming Eagle, an aircraft sales and maintenance shop, "but once you walk around and see what all is going on, you say, 'God, there's a lot of people here.' " The privately owned hangars where resident pilots keep their aircraft are uniformly plain on the outside but strikingly different on the inside. Some are a jumble of partly assembled airplanes, parts, battered signs, old cars, motorcycles, banners, bicycles, worn furniture, work benches, and tools. Others are showcase-neat, and in some cases display collections of art and painstakingly restored antique radios and appliances.

"Hangars here reflect individual personalities, and collectively that forms the spirit of this airport," says Mike Dewey, Jim Dewey's son. Until recently, Mike sold airplanes and offered flight instruction at the airport, just as his father did after World War II until he died in 1989. Dewey's own gleaming hangar includes, among other items, an open-wheel racing car, Coca-Cola signs, vintage home appliances and photographs, a Foss Goodyear Midget racer,

CAROLINE SHEEN

From a 1950 Navion on final approach, the Topatopa mountains loom large, but they're just background down on the runway (far right), where John Thorne taxis in his 1975 Cassutt Racer, a mighty midget with a 15-foot wingspan and a 100-horsepower O-200 engine.

and a sport airplane designed and built by his father.

Dewey came to Santa Paula in 1953, when he was 13 years old. With the help of his father he built a glider from tubing salvaged from a derelict Cessna UC-78 and the wings of a J-2 Cub. He graduated from Santa Paula High School, got his private pilot's license, and quickly earned his commercial pilot and instructor's ratings. He followed up with an airframe-and-powerplant mechanic's license from a two-year college, then bought a hangar at the airport with the help of Ralph Dickenson.

"I was scared to death of Ralph," says Dewey. "He was a benevolent dictator—and a visionary. He acted real tough, but he had a heart of gold underneath. They were building these hangars out of junk wood and junk tin, and I bought one for about $1,600. It didn't have any doors on it, and there was a big pile of dirt right in the middle. I said, 'Ralph, what about that dirt?' He said, 'If you want the hangar, you take it with the dirt and you put the doors on.' "

With equipment borrowed from Dickenson, Dewey moved the dirt, built new doors, and at the age of 19 hung out a shingle for "Mike Dewey Aviation." He started his flight instruction business with a single Piper Cub, later added a couple of helicopters along with other aircraft, and began teaching aerobatics. Eventually, he moved to bigger and better hangars, and the company evolved to include an aircraft dealership. Meanwhile, Dewey became a

Bob Phelps is president of the Aviation Museum of Santa Paula, founded in 1999 to preserve the airfield's history. When working in the museum's main hangar, Phelps is often accompanied by Red, the airport cat.

Vital Stats

SANTA PAULA AIRPORT

Opened: Dedicated on August 8 & 9, 1930.

Dining: Try Logsdon's Restaurant, located at the airport. For information on food and lodging, check out *www.santapaula airport.com.*

Don't Miss: Watching old movies of Golden Age pilots in the airport's museum at the open houses held on the first Sunday of each month. Hours: 10 a.m. to 4 p.m. For more information, visit *www.amszp.org* or call (805) 525-1109.

Cost: Free admission.

movie stunt pilot and then an aerial stunt coordinator, finally retiring a year and a half ago after 35 years. "I've been on this airport since I got to town," he says, "and I pinch myself every morning that I've been able to be a part of this place. The whole thing about this airport is that everything was done for the love of aviation and not for profit. All these people have put so much time and effort into this airport, and they did it for nothing. Ralph Dickenson wanted to build an airport for the community where regular people could afford to own an airplane. And that spirit has never left. Never."

Walt Marple, owner of Marple Aviation, presides over a crowded working hangar.

Privately owned hangars look like mini-museums. Mike Dewey's hangar (top, right) features a mint-condition BMW motorcycle and the Dewey Bird, *a sporty monoplane designed and built by his father. In Reg Pridmore's space (above), a mannequin stands guard over the former motorcycle racing champion's collection of bikes and his Swift airplane.*

Inside are a partly disassembled Boeing PT-17 Stearman and a Naval Aircraft Factory N3N trainer, both under restoration. "We do general maintenance, modifications, and overhaul," he says, "everything from antiques to—you name it—sheet metal, fabric, wood, plastic."

Thirty-five years ago, while working as an aerospace engineer in Los Angeles, Marple met Matt Jefferies, the original art director for the first "Star Trek" television series and a pilot who kept his airplane at Santa Paula. "Matt bought a black and white 1935 custom Waco YOC," says Marple. "We wound up going down to bare bones and completely restoring it—11 years of weekends." Twenty-five years ago, Marple moved to Santa Paula for good.

Over the years, visitors to Santa Paula had the opportunity to meet Jefferies, who died last year at the age of 82. Revered by Star Trek fans as the designer of the Starship

Enterprise, he had maintained a hangar at Santa Paula even though failing eyesight prevented him from flying. Up until the end, he would receive visitors in the comfortable studio loft he had built in his hangar. Surrounded by mementos and paintings, including his own works and a scale model of Benny Howard's famous 1930s racer, *Mister Mulligan*, Jefferies would reminisce about his flying days. "In 1967 I bought the Waco, which had been tied down in the weeds back of a hangar in Reno for months," he told me shortly before his death. "Once I got it—every Saturday, Sunday, and holiday—I'd usually unlock this place about seven o'clock in the morning, then get home in the evening in time for dinner, and the next morning I was up here again. I lived 55 miles away near Universal Studios. We did a lot of traveling in the Waco when it was done, usually in conjunction with work. We used to put everything in it that I needed and be gone for two or three weeks on location." In 1986 he retired as an art director for films and television, and in 1999 he donated his elegant old Waco to his home state, Virginia—it can now be seen at the Virginia State Aviation Museum in Richmond.

Other old birds are still here, though. Inside Joe Krybus' hangar, a bright yellow Bücker Jungmann biplane awaits finishing touches. Next to it is the skeletal fuselage of another Bücker. Krybus is a restorer and a specialist in this graceful German sportplane. "I make complete restorations from the ground up," he says. "I work it alone. I do everything—wood, metal, welding, engine mounts and installation, but not the engines themselves. I don't have a Bücker of my own. I'm too busy working for other people."

Two other old birds still here are de Havillands: a Gipsy and a Tiger Moth, both in Dave Watson's hangar, both in fine flying condition. "I've been at Santa Paula for 10 years," says Watson, a design engineer at the Lockheed Skunk Works. "This is a surviving 1930s airport. The support for having old airplanes is here. If you take airplanes like these and go into a modern general aviation airport, they're not always appreciated. They're too slow in the pattern, some don't

have radios, and we like to burn 80-octane aviation gas, which is almost extinct. This airport has welders, it has fabric people, it has engine people, there are parts, there is knowledge and a willingness to share it with each other and with outsiders."

One of the fabric people is Rowena Mason of Rowena's Flying Fabric Company, motto: "We'll keep your ribs in stitches." In 1985 she bought a Piper Cub and hopped around the small airports of southern California, working at office jobs. "I didn't like it," she says. "I wanted to find a way to hang out at the airport all day."

In 1990 she moved to Santa Paula, commuting 40 miles in her Cub to Van Nuys Airport, where she worked in a fabric shop. In the beginning she worked for free, just to learn the trade, and then for $5 an hour. At the same time, she worked nights as a waitress. In 1990, she met her future husband, Pete Mason, a corporate pilot who already had a hangar at Santa Paula. Now they run the fabric shop together and sometimes tow banners with their Stearman.

Al Ball came to Santa Paula and began flying at age 13. In 1974 he started an engine repair business. As a favor to a friend, he rebuilt a Kinner, a five-cylinder radial engine that powered the Ryan PT-22 trainer during World War II. He had tapped an undiscovered market, and today he is known as the world's leading expert on rebuilding Kinner engines. "I have a five-year backup for Kinner repairs," he says. "Customers come from all over the U.S., Europe, and Australia. Now I have one in Mexico."

Dan Gray, a United Airlines Boeing 777 captain, owns two spotless modern hangars off the west end of the airport. "I started when I was 14, soloed on my 16th birthday, on my 17th got my private license, 18th got my commercial and CFI [certified flight instructor] and started teaching," he says. At 23, Gray went to work for United. "I couldn't wait to get out of Santa Paula, because I was tired of a little town," he confides. "About 15 years later, I couldn't wait to come back."

When he returned, he started Aviation F/X, which for several years built radio-controlled flying models for television commercials and such movies as *Flight of the Intruder* and *Black Angel*. "Most of the ones I made got blown up," he says. Gray has now switched to building full-scale aircraft kits. "I've built seven full-sized airplanes," he says. "It's good for me to get out here and work on airplanes all day." He appreciates the diversity at Santa Paula: "If you want an expert in any field, you can find

Roger and Cheryl Orr (seated) watch over their 1932 Howard, Mr. Hooligan. *Roger restored the airplane after buying it three years ago in New Mexico.*

DAVID PETERS

Santa Paula's antique airplane community attracts colorful visitors. Last fall, a pristine biplane flew in for an open house, making for another beautiful day at the airport.

one here. The best welder in the world [Mike Jewett] is at Santa Paula and so is one of the best paint shops [Santa Paula Aircraft Painting] in the country."

Dan Torrey, proprietor of MARS Aviation, is probably the nation's leading specialist in Bellanca airplanes. MARS stands for Mobile Aircraft Repair Service: If you can't bring in your aircraft, Torrey will come to you. "I have owners all over the West," he says, "and some customers come over from Phoenix, Arizona, just for an oil change. I'm so busy now, the minute I push an airplane out of the hangar, I'm waiting for another one to come in. I have airplanes stashed in hangars all over the airport in different stages of restoration."

Though Santa Paula's hangars are filled with antique airplanes, their numbers were once even higher. Some that were restored and flown here have drifted off to museums around the country. At the same time, much of the energy and creativity at Santa Paula have been channeled into more modern aircraft. Lancair, the popular kit maker, started at Santa Paula but outgrew the airport several years ago and moved operations to Oregon. In one of Dan Gray's hangars sits a bright red Legend, a kitplane he built and kept for himself. Capable of 300 mph, it is arguably the hottest airplane at the airport.

Vicki Cruse, a member of the U.S. unlimited aerobatic team, keeps her Edge 540 here. Santa Paula has long been a center for aerobatic training, due in large part to Mike Dewey and to Rich Stowell, who runs the Aviation Learning Center, where he teaches spin recovery and aerobatics. His course is known worldwide and each year draws a contingent of Japanese pilots. Dewey's and Stowell's businesses are helped by the presence of a designated aerobatic airspace three miles east of the runway.

Hang around the airport long enough and you'll begin to hear about Santa Paula's brushes with celebrity. On September 28, 1968, a 66-year-old Charles Lindbergh visited the airport at the invitation of an old friend, Bud Gurney, who had barnstormed with him in the 1920s and then taken over his mail route when he left to make his historic flight to Paris. Gurney, long since retired as a United Airlines captain, had hangared his Gypsy Moth at Santa Paula since 1963. Together, Gurney and Lindbergh went flying that day, and Bud's son, John, followed in a second Gypsy Moth. John recounts that they had all flown up to a little country strip in the mountains, sat around on the grass and talked for a couple of hours, and then had flown back.

Actor Cliff Robertson once had a fleet of antique biplanes here, and even though he now lives in New York, he still maintains a hangar at Santa Paula and a Stampe biplane in flying condition. Actors Gene Hackman and Leonard Nimoy and famed Lockheed test pilot Tony LeVier all used to fly here often. Apollo 11 astronaut Buzz Aldrin visited several times, once thrilling the airport crowd when he arranged for a Boeing 747 carrying a space shuttle to fly by. And anyone can point out the hangar where the late film star Steve McQueen, who was taught to fly by Mike Dewey, kept his Stearman and his racing motorcycles. McQueen once described Santa Paula as "my kind of country club," and he was no doubt attracted to the unpretentious atmosphere.

It had been Ralph Dickenson's dream to build a plain and simple airfield, and the Santa Paula of today is a reflection of Dickenson's long rule; he stayed on as president of the board of the Santa Paula Airport Association for 45 years and continued to manage the airport for another five. After he retired as association president, his son, Don, served for 16 years, and then in 1997, grandson Bruce took over for four years and still serves on the board.

Ralph Dickenson continued to fly until he was 89, and in the last few years he owned a Cessna 180, which he bought without a radio. (His hearing was going, and he never liked radios much anyhow.) He died in 1985, at the age of 91. Up to the end, though, he came to his airport and pulled weeds to keep the place tidy.

The story of a little-known World War II alliance: French air cadets, Southern flight instructors.

by Janelle Dupont

FRENCH LESSONS

COURTESY RENE LEVLOUE

The student pilot knew he hadn't performed well, and back on the ground he waited for a chewing out by his flight instructor. Instead, the exasperated instructor marched him over to another officer on the flightline and told him to give the student hell—in French.

The obliging officer was my father, Harry Dupont. It was 1943, and he and his fellow U.S. Army Air Forces flight instructors at Gunter Field in Montgomery, Alabama, were struggling to turn young Frenchmen into combat-ready pilots. Eventually, a partnership between the U.S. Army Air Forces and the Free French would bring nearly 5,000 Frenchmen to the United States to train for air crew and ground support positions during World War II. Though few U.S. instructors were able to speak much French, from 1943 to 1945, nearly 1,400 French recruits learned to fly over the piney woods of the American South.

Despite the language barrier, French air cadets sent to the U.S. South managed to have some fun—and learn to fly.

In primary training, an interpreter helped with post-flight critiques, but when the cadets moved on to basic training in Vultee BT-13s (below), the interpreters were left behind.

When the Germans took over France in 1940, they devastated the country's air force, destroying hundreds of French airplanes, confiscating others for their own use, and grounding yet others by removing their propellers. Under the terms of the French-German armistice, the Germans permitted only a few French air force units to operate in France and its North African colonies, and only under German control.

Before the takeover, some pilots managed to fly to England, where they joined the Royal Air Force and flew missions over France and Germany. Eventually the exiled French banded together to form the Free French air force.

In November 1942 the Allies invaded North Africa, defeating the Axis forces there and liberating the French units in Algeria, Morocco, and later Tunisia. These units joined the Free French.

The Free French asked for U.S. aircraft and training to help re-create the French air force. In early 1943 the U.S. military agreed, seeing the benefits of the arrangement. The Allies needed more fliers, and the French had experience in North Africa. But North Africa did not have enough instructors or training fields, so U.S. Major General Carl Spaatz proposed that French student pilots be sent to the United States for flight training.

The French cadets who jumped at the chance to come to the United States for flight instruction had grown up at a time when boys read of World War I aces and dreamed about flying in combat to defend their country. German troops had taken over their towns, and they knew the traumas of occupation.

In November 1942 the cadets were subjected to preliminary testing of their physical and mental abilities, as well as some ground school subjects, such as navigation and gunnery. Those who passed were told to report to Camp Cazes in Casablanca, Morocco, a French air base with two sections, American and French. There the French got their first glimpse of Allied airpower. Compared to France's aging fleet, the aircraft—Spitfires, P-40s, P-38s, B-17s—were awe-inspiring: roaring, swift, and lethal.

One cadet, René Levêque, later recounted his amazement in a 1982 article in *Aerospace Historian*: "It was on the apron of a hangar in Casablanca that the future French cadets beheld the B-17 Flying Fortress for the first time. It dwarfed all other planes."

The training plan called for the French cadets to undergo primary training at a civilian facility near Tuscaloosa, Alabama, basic training at Gunter Field, advanced single-engine training at Craig Field, near Selma, and twin-engine training at Turner Field, outside Albany, Georgia. Later, more highly specialized training centers were established throughout the country, among them Tyndall Field in Florida for machine gunners, Lowry Field, Colorado, for armament technicians, and Scott Field, Illinois, for radio personnel.

The U.S. Army had experience training foreign air cadets. It had just concluded a two-year program in which 4,000 British cadets were sent to U.S. bases for flight training. But the British had provided some of their own instructors. The French, on the other hand, had no instructor pilots to spare. Many were stuck in France or languishing in German POW camps.

By early 1943, the search was on for instructors who could communicate with the French.

That January, my father graduated from Craig Field as an Army Air Forces fighter pilot. Hoping to use his new skills overseas, he was soon disappointed. "They wrote me asking if I would be interested in teaching basic training to Frenchmen," he recalls. His heritage had worked against him: He was a Louisiana Cajun, or Acadian—a descendant of French Canadians who had fled British rule 250 years ago. French was my father's first language, and in the 1940s, when visiting his parents in southwest Louisiana, he still spoke mainly French.

"I wrote back and politely said no, I would rather take a combat assignment," he recalls. "I got a second letter that was no longer a question but an assignment."

Other pilots who had indicated a knowledge of French on Army personnel records received similar "invi-

FAR LEFT: AFHRA; LEFT: COURTESY MAXWELL AFB HISTORY OFFICE

tations." Besides those of Cajun descent—men with names like Pellerin, Hebert, and Gautreaux—the Army recruited college French majors and the sons of wealthy families who had learned French from their nannies or during summers in Europe. Some instructors recruited for the effort spoke little or no French at all. Nineteen-year-old flight instructor Jack Wishnick saw a recruiting notice at a Greenville, Mississippi base. He had taken two years of high school French and failed the second year. But he was keen on transferring to Montgomery to be near a woman there. He managed to pass the language test by reciting one French sentence he had memorized.

"When the first group [of students] arrived, I finally had to tell my commanding officer I didn't speak French," says Wishnick. "He said that in my first group he would give me students who knew some English. Then he grabbed me by the neck and told me, 'By the end of 10 weeks, you better be fluent in French and they better be fluent in flying. Or you'll be doing night flying the rest of the war.' "

Ed Vorrier was stuck with instructor duty because the military thought his name sounded French. He protested that he was of German-Irish descent and spoke no French, but to no avail. He eventually learned French on the job. Some air fields offered French courses for the U.S. instructors, though the instructors I interviewed years later don't recall them.

The first detachment of French air cadets, about 100 enlisted men and officers, left Africa and sailed for the States on June 14, 1943. On arrival, a train took them to Craig Field for processing.

Years later, I asked one of that first group, René Levêque, what he thought of Alabama.

"Alabama? Alabama? What did I care about Alabama? We were in America!"

Jean Pichon, who arrived with the second French detachment, was amazed at what he saw. He had grown up in Bordeaux, and when he'd left the previous year, the town had been battered by food shortages, blackouts, and executions carried out by the Germans at night. Pichon remembers well his first impressions of 1943 America: "Everyone was happy. There were factories going, there was work, money, plenty to eat. And at night everything was lit up!" At his first meal at an Air Forces facility, he couldn't believe all the food laid out: eggs, butter, meat, milk...

The young recruits received their primary training at the Alabama Institute of Aeronautics at Van de Graaf Field, near Tuscaloosa, a field that had been recently carved out of farmland. Civilian instructors conducted primary training through interpreters, including, according to the *Tuscaloosa News*, "Mrs. Marguerite Taliaferro, a University French teacher, and Mrs. Gerrie Thielens, Tuscaloosa author."

On the flightline, instructors told students what maneuvers they would practice, and the translators did their best to explain the upcoming lesson. The *News* described the process as follows: "Before flying periods American instructors address Frenchmen on the flightline in long slow voices. Interpreters, waiting for convenient pauses, blaze out the same thing in lightning French.

"The students, on an average of 22 to 24 years old, lean and blackened by the African sun, listen eagerly, hang on every word."

In PT-17 Stearman trainers, instructors used hand signals to indicate the next maneuver, such as a climbing turn, a lazy-eight, or a power-on stall. (Later, hand signals were standardized and explained in French-language instructional materials.) René Levêque recalled inflight communication in his *Aerospace Historian* article: "The PT-17 Stearman used in primary training in 1943 was a 200 hp biplane with a narrow undercarriage, an open cockpit, only basic instruments, and no electronic intercom system. When the instructor had something to say, he talked into a kind of funnel, hoping that the roar of the engine, the hiss of the slipstreams, and the lack of concentration, or the bewilderment of his student did not cancel his message. When his words did reach attentive ears, it was always garbled, and almost invariably in a for-

PIERRE-ANDRE DUFETEL

While in the States, cadet Pierre-André Dufetel sketched cartoons that poke fun at both students and instructors. The caption accompanying the diving airplane on the left reads: "Strive to put him at ease when you are flying."

COURTESY JANELLE DUPONT (2)

Two species of trainers: Harry Dupont and an AT-6 (top). After Alabama, cadet Jean Helye (above) eventually rose through his own nation's air force, retiring as a general.

eign language. Well planned lessons previewed on the ground with the instructor and a translator and strictly adhered to in the air were a must, with arms, head, finger, and hand language to the rescue."

Once they were back on the ground, the students were critiqued. "*Regardez bien autour de vous!*" ("Look around") was a typical post-flight comment, as well as "*Ne vous crispez pas!*" ("Don't tighten up"). But the flight instructors never were able to come up with a French equivalent of "Get on the ball!"

French texts and soundtracks for training films weren't available until January 1944, and formal English language training did not begin until April, 10 months after the arrival of the first detachment.

Nonetheless, the first group of 100 achieved an impressive 75 percent success rate at primary training and thus avoided reassignment to navigator or other non-pilot training. (Socially, they appeared to have been successful as well: The August 14, 1943 issue of the military *Training News* reported that "Americans at Van de Graaf like the enthusiastic, voluble French better than the reserved British cadets who preceded them.") In September, the pilots moved on to Gunter Field for basic training.

Basic posed new challenges for the French: instrument flying, night flying, cross-country flying—all without interpreters. The cadets trained on the BT-13 Vultee Valiant, which was bigger and heavier than the Stearman and also had a two-way radio and a dual-pitch propeller. In 10 weeks of training, each student pilot logged about 70 hours in the BT-13.

Basic was a learning experience for both instructor and student. My father's Cajun French had an antiquated vocabulary that reminded the students of language from a 200-year-old book, but it served him well. "We were at home with French," he says. "I think they understood us better than some of the instructors who learned it in college." He created a dictionary for his fellow instructors of common aviation terms, with the French words spelled phonetically.

Problems other than language cropped up. Compared with Americans, the French had more vision problems that eventually disqualified them. They were also shorter, perhaps due to a poor diet in the years after World War I. Some French students compensated by using extra cushions on their seats. Later, the AT-6s' rudder pedals were fitted with extenders.

The U.S. Army Air Forces' *History of Gunter Field, June–December, 1943* describes how the French students' approach to flight training differed from that of U.S. students: "They [the French] have the old world conception of education. That is, they are more interested in the theory than are our cadets, so they are more favorably disposed toward the Ground School compared to our cadets who are more practical and think that only flying is important."

U.S. officials made concessions to some cultural differences. For example, the French military included "aspirants"; these were analogous to U.S. "flight officers," but without a commission. So Turner Field officials let the aspirants there live in the student officers' quarters and frequent the officers' club.

Instructors remember that some French cadets, particularly those from rural areas, lacked mechanical ability. "A lot of them hadn't even been around cars," recalls Jack Wishnick. "I mean, we could at least adjust a carburetor." But he respected their courage and desire to fly, especially considering what many of them had gone through to escape German occupation. "Some of them had walked across the Pyrenees," he says.

Basic training was a high-pressure, potentially dangerous business, especially for those still scrambling to learn a second language. Initially, the French accident rate in basic was higher than that for U.S. cadets. My father once saw a formation takeoff in which the French student, instead of turning smoothly, turned hard left, colliding with another airplane and killing him-

self and his instructor. (Not all the accidents were the pilot's fault, though. Once, a Gunter ground crew forgot to replace an aircraft's gas tank cap, and as soon as the French student made his first maneuver in the craft, fuel spilled onto the engine and set it on fire. The aircraft went down behind a hill. Sometime later, the student pilot walked through the base's front gate carrying his parachute and announced sadly, "*J'ai perdu mon avion*"—I lost my airplane.)

As time went by and both students and instructors became better at each other's languages, the French cadets' accident rate dropped to about the level of the U.S. cadets. Tighter discipline on the ground also helped cut accidents, especially on solo flights. "In the early stages of the French program, instructors were allowed to maintain a friendly and informal relationship with the students," recounts one report. "It was felt that they had undergone great hardships, shown great initiative, and were in a difficult position, being in a strange country. In 1944, in order to lower the accident rate, and to put the program on the same basis as the American program, the relationship of instructor and student was limited strictly to the flight line, and [conversational] subjects [were confined to] flying, while on the line."

Adjustments made on both sides seemed to help. Of the first group of 75 French cadets at Gunter, 72 graduated and earned high praise. According to an Army report, they had shown "zealous enthusiasm" in most aspects of training.

Still, the language problems that had surfaced early in training sometimes continued into advanced training. According to a history of Craig Field, where pilots received single-engine instruction: "During the first part of their training [at Craig], the eager students had the tendency to indicate that they understood the instructions or explanations of their instructors, when actually the procedure under discussion was still a little vague to them."

Eventually, 24 detachments of French cadets moved through primary, basic, and advanced training, earning their wings after more than 200 hours of training flights.

In 1998, I began asking my father about his experience training the Free French. He had flown with them, cussed at them, and celebrated with them at graduation, but he knew little about what had happened to them after their training days.

In August 1945, the French government had awarded my father French pilot wings, citing his contribution to the liberation of France. After the war, he served as a pilot in the Air Force Reserves, retiring as a captain in the 1950s and later working in corporate finance. We wondered if any of the French students had also stayed in aviation, so we placed a notice in a French air force publication. The responses started coming in:

"I was a student pilot at Gunter Field from July 3 to August 31, 1945," wrote Andre Graveret. "I left the [French] air force in 1966 after 25 years of service with the rank of colonel."

Jean Helye wrote that he remembered flying with my father when he was 19 years old. The retired French air force general had flown in combat in Indochina and Algeria, and later worked for the French aerospace manufacturer Aerospatiale.

Isabelle Degoy wrote, "My father, Marc Roche (class 45-I), on his return to France pursued a career in the French air force. He had tours of duty in France, Algeria, Morocco, Tunisia, Indochina, and Germany and flew on combat airplanes from the Spitfire to the Mirage."

"I have some commonality with your father as I myself was a flight instructor on the T-6 during the Korean War," wrote René Levy.

Before long, we learned of the As-

Student Jean Pichon (below, left) and instructor Harry Dupont reunited in France last year. Bottom: Instructor Herbert Cain introduces his French students to their new trainer.

RIGHT: AFHRA; ABOVE: COURTESY JANELLE DUPONT

sociation Personnel Navigant Formé en Amérique—the Association of Flying Personnel Trained in America. The group's reunions, publications, and Web site enable the former French cadets to keep their memories alive. My father and I submitted a notice to the APNFA publication and more letters and e-mails arrived.

In August 2001, we met René Levêque. The former trainee at Gunter became an instructor there and later married an American and settled in Alabama. He taught French and Spanish and until recently was an active pilot. At his home in Wetumpka, Alabama, he and my father pored over logbooks and photo albums. The two shared memories of Gunter: round-the-clock flight schedules, hurrying a landing when a thunderstorm was approaching, and, when things simmered down, the pool parties at the officers' club.

The following year, we accepted an invitation to attend an APNFA luncheon at the Aero Club de Paris and visit several pilots in France. When the group's president, French air force General Theodore Mahlberg, addressed the group, he thanked my father and added, "You instructors were the first ones to teach us how to conduct ourselves as professionals—as pilots and in our careers."

General Jean Helye brought his photo album, with images of his year in America. One photo showed a smooth-faced 19-year-old peering out of an AT-6 cockpit; another, a young man in a flightsuit gulping down a Coca-Cola.

All had stories about their days after Gunter Field. Jean Kisling served as a P-47 instructor in Michigan. After the war, he embarked on a career as an Air France pilot, eventually logging more than 26,000 hours. In 1945, Robert Camby served as a B-26 Marauder instructor near Dodge City, Kansas. Eager to join his friends from the first detachment, he was finally posted to Naples, Italy; a week later, the war in Europe ended.

Hugues Robin opened his Paris home to us and pulled out maps, memorabilia, and photographs, including one of him and three buddies relaxing in front of their barracks in Alabama. The handsome teenagers smiling back at us seemed to say, "We were the lucky ones"—to be 18, flying, and discovering America.

All the French pilots who had trained in the United States had received both French and U.S. wings, and at Maurice Pochet's apartment near Cannes, he showed us his, encased in a glass globe. After training, Pochet flew the P-47 Thunderbolt, the war's largest single-engine fighter, over Germany. "Oh, that was a great airplane," my father said. Pochet made the thumbs-up sign. "A champion," he agreed.

Jean Pichon welcomed us to his retirement home in southwest France. His training done, he had served with a French fighter group in Italy, flying P-36s, P-39s, and P-63s. He went on to fly for Air France, a job he held for 40 years. His living room was filled with evidence of his 26,000 hours flying DC-3s, DC-4s, Constellations, and other Air France transports.

On Veteran's Day, 2001, my father, my two sisters, and I stood quietly at Oakwood Cemetery in Montgomery, Alabama, as a bagpiper wailed a tune and French and British flags snapped in the wind. About 150 people gathered to pay tribute to fallen French and British pilots of World War II. Twenty of the 100 French pilots who died in the United States are buried at Oakwood, alongside 80 British pilots. My father, 81, and René Levêque, 79, placed a wreath from the APNFA on a memorial plaque.

The ceremony is held every November on the peaceful, windy hillside that is the pilots' final resting place. Levêque attends every year.

The cemetery is the most visible reminder that French student pilots once raced across the skies of Alabama. Van de Graaf Field is now Tuscaloosa Municipal Airport. Gunter Field, now Gunter Annex, is no longer an airfield but an Air Force educational facility.

In France, the signs of the remarkable collaboration are also modest. Outside Paris, at Le Bourget Airport's Musée de l'Air et de l'Espace, a small PT-17 Stearman sits among World War II aircraft that are far more impressive-looking. Still, the Stearman bears witness to those days on a faraway dusty field when nervous young men first took to the air in the hope of flying for a liberated France.

With the help of a commemorative sign, a BT-13 marks the location of Alabama's Gunter Field, where in 1943 French air cadets answered the call to service (right).

FAR LEFT: COURTESY JANELLE DUPONT; LEFT: COURTESY MAXWELL AFB HISTORY OFFICE

Accidental Discovery of Mysterious "Gold Rush" Coin Stuns Experts

World's Rarest U.S $20 Gold Proof Found: The San Francisco Mint 1854 Double Eagle Proof!

WASHINGTON, D.C—A one-of-a-kind U.S. Treasury gold proof coin has been accidentally discovered within the vaults of the Smithsonian Institution. This 1854-S gold Double Eagle $20 coin was struck by the San Francisco Mint in its first year of operation. The San Francisco Mint was born out of the need for a Western Frontier Mint when, in January of 1848, gold flakes were discovered at Sutter's Mill triggering one of the most important chapters in U.S. History—The California Gold Rush! To the surprise of historians, this single "S" mint Proof coin was individually struck from specially polished minting dies. How this unique Proof Double Eagle made its way across the continent and then into the hands of the Smithsonian Institution is an unsolved mystery to this day.

Today the First Federal Mint announces the public release of the first ever gold Proof commemorative honoring this rarest U.S. Government $20 gold piece This 10mil gold Proof has a frosted image against a deep mirror field, creating a breathtaking work of art in gold. This 150th anniversary Mint release honors the legacy of a true historic masterpiece.

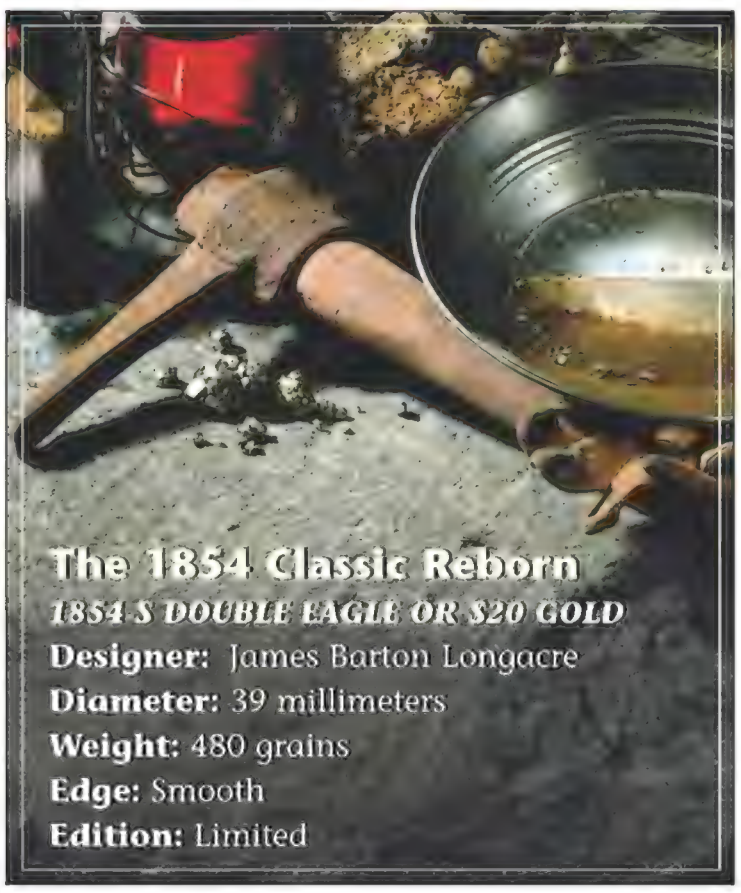
The magnificent 10mil gold proof measures a full 39mm diameter to truly showcase the beauty and intricacy of this legendary coin design. The 10mil gold proof is available only through this limited edition, private release from the First Federal Mint at the advance issue price of $19.95 each.

Fabulous Rarity Valued at $12 Million

Only one original proof coin is known to have been struck. Even the foremost rare coin experts were unaware of its existence until it was accidentally found deep in the vaults of the museum. America's foremost authority on U.S. gold coins, David Akers, has written, "the 1854-S Double Eagle is easily the most significant and desirable branch mint proof coin in existence". With the recent auction sale of one of the three 1933 St. Gaudens Double Eagles for $7.9 million, senior numismatist Nicholas Bruyer estimates the unique 1854-S Proof Double Eagle would bring at least $12 million if it ever becomes available at auction.

The "Gold Rush" Coin.

2004 marks the 150th anniversary of this historic mint striking. The First Federal Mint is releasing this mint quality 10mil gold Gem Proof collectors coin to honor the legend, lore and legacy of the 1854-S Double Eagle!



Special Discount for Advance Orders.

The issue price for the special 150th anniversary 1854-S Gold Proof commemorative coin has been set at $50.00. However during the advance release period only, you may reserve your own 10mil 24k gold Gem Proof for only $19.95.

Your 1854-S Double Eagle 150th Anniversary Gold Proof will be protected in a clear acrylic holder and mounted in a deluxe presentation case. A signed and numbered Certificate of Authenticity will attest to the specifications and Limited Edition status of this exclusive private mintage.

Your order must be placed during this advance issue period to qualify for the $19.95 price. Multiple orders of five or more will be priced at $17.95 per Gold Proof. You must be 100% satisfied with your order, or simply return it within 30 days by insured mail for a prompt refund of the purchase price.

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How Things Work:

Electro-mech

by Tim Wright | Illustrations by John MacNeill

On March 19, 2001, Comair flight 5054 took off from Nassau in the Bahamas, en route to Orlando, Florida, with 25 passengers and three crew members. At about 6:22 p.m., while cruising at 17,000 feet, the aircraft entered a bank of freezing rain clouds. Pebble-like ice began to coat the airfoils and control surfaces.

Immediately, the pilots activated the deicing "boots," inflatable rubber tubes mounted on the wings, to break the ice off. Nevertheless, within a few minutes so much ice had accumulated that airspeed decreased nearly 70 knots (80 mph). Flight 5054, an Embraer EMB-120 twin-engine turboprop aircraft, began to roll and lose altitude. Only after it plummeted 7,000 feet before emerging from the clouds and exiting the icing conditions were the pilots able to regain control and make an emergency landing in West Palm Beach.

Within the last 10 years, inflight icing has caused two airliners to crash, with all on board being killed, and interest in anti-icing measures has grown markedly. In the interest of safety, the Federal Aviation Administration and NASA have teamed up to improve aircraft ice protection systems.

Ice is most dangerous when it accumulates on airfoils, disrupting airflow and causing a stall, as in the case of flight 5054. In order to gain approval to fly for extended periods in "known" icing conditions—ice that has been reported or forecast—aircraft must receive FAA certification by demonstrating that they are capable of doing so safely. To win certification, aircraft must employ either deicing systems, which shed ice accumulations, or anti-icing systems, which prevent ice from forming. A new system, Electro-Mechanical Expulsion Deicing, does both: It combines anti-icing and deicing measures. Developed by Cox & Company, a manufacturer of electro-thermal systems for marine, aviation, and rail applications, EMEDS is the first ice protection technology to receive FAA certification in 50 years. In 2001, it was certified for use on Raytheon's Premier 1 business jet.

In the Icing Research Tunnel of NASA's Glenn Research Center in Ohio, granular "rime ice" chunks obliterate an airfoil's smooth surface.

NASA GLENN RESEARCH CENTER

The technology works in conjunction with previously developed ice detection systems and is triggered automatically once sensors detect ice. First, an electro-thermal strip heats the wing's leading edge to just above freezing, melting the ice. Other electro-thermal systems heat the leading edge enough to evaporate moisture on contact, preventing it from escaping and refreezing elsewhere as "runback" ice. Such thermal evaporative systems, like those using engine bleed air, require constant high power. "We heat the leading edge but

anical Deicing

When an electrical current pulses through an EMEDS coil, the coil slams against the airfoil skin.

don't evaporate," says Kamel Al-Khalil of Cox & Co. EMEDS solves the problem of runback ice by "keeping the water in a liquid state—a very thin film that doesn't affect airflow," says Al-Khalil. "The water flows downstream and eventually freezes where the aircraft is less sensitive to airflow disruptions. That's where [the deicers] hit it."

The deicing component of the system includes two sets of elliptical-shaped coils, or rolled circuit boards—one set for the airfoil's upper portion and one for the lower. The coils are installed behind the heated strip, between the aircraft skin and a rigid housing. An electrical current is sent through one set of coils at a time, and as the current loops through the coil, it flows in one direction and then the opposite, inducing a magnetic field. The upper and lower portions of the coil then repel, changing the coil from an elliptical shape to a more circular one. The shape change, in turn, causes the coil to flex the aircraft skin and break the ice's grip. Jolted with electrical energy pulses that last .0005 second, the coils deliver impact accelerations of over 10,000 Gs to the airfoil skin once a minute, shedding ice as thin as .06 inch. Despite the high G-load, the impact amplitude—the amount of movement of the aircraft skin—is only about .025 inch. The skin accelerates so rapidly, though, that ice de-bonds as if hit with a hammer.

Despite the impact loads and frequency, metal fatigue isn't a problem, according to Al-Khalil. "We've run millions of cycles" on test airfoils, he says, a duty cycle many times what an airfoil typically experiences in its lifetime, without damage. The system's service life is better than that for rubber boots, which require regular replacement when the rubber degrades. And the EMEDS system doesn't disrupt the airfoil shape, as the boots do.

Mechanical deicing may also replace systems using anti-icing/deicing chemicals, which seep out of fine holes in the leading edges of airfoils on aircraft like the Cirrus. Fluid use on the Cirrus is certified only as "No Hazard" to normal flight operations. Chemical systems can be used only in unforeseen and emergency icing conditions.

At 28 volts and less than 10 amps aboard the Premier 1, EMEDS's power requirements are attractively low compared with the engine bleed air or electrical power demand of thermal evaporative systems.

Raytheon uses EMEDS in the Premier's tail section and will include it in its other jets. To anti-ice wings and ensure that no fragments reach the engines, the company will continue to use engine bleed air.

EMEDS won't see wide use in transport aircraft until it is included in aircraft design—literally built into the wing. But it may be accepted faster in smaller general aviation aircraft, where bleed air isn't available and weight and electrical power limitations are stringent. Many pilots prefer evaporative anti-icing systems. Says Al-Khalil, "Pilots want to use all anti-ice systems. They don't like deicing, but they'll live with it."

Raytheon's Premier 1 business jet.

RAYTHEON

Star Power

Franklin Chang-Díaz will need more than an astronaut's

He built his first rocket when he was seven. It was a big cardboard box, fueled with the imagination of a Costa Rican boy who in October 1957 went to great heights for a closer look at Sputnik: He climbed a mango tree. From his perch, the satellite that launched the space race was a twinkling star racing past all the others in the heavens. Franklin Chang-Díaz knew then that his future was in physics. "I wanted to be like Wernher von Braun and Robert Goddard," he says. "I wanted to design rockets." That he spoke no English and lived in a country with no space program were inconveniences, not obstacles, to the young student, who eventually worked his way to the United States, immersed himself in the language, became a citizen, and made his dreams come true as an American astronaut.

The boy who climbed the mango tree is now 53. He has been to space seven times, and, probably more than most astronauts, he ponders the fact that in nearly half a century, not much has changed about the way humans get there. They

still rely on rockets that use chemical combustion and travel no faster than the missiles that carried the first astronauts into Earth orbit. The chemical combustion rocket "has given us the capability to go to the moon and establish a permanent presence in space, but it cannot go farther than it already has," he says. "If we are going to do any serious exploration of the solar system, we have to develop a new type of propulsion that increases performance by orders of magnitude."

Today, one of the most controversial proposals for a new type of propulsion is a product of Chang-Díaz's imagination. His Variable Specific Impulse Magnetoplasma Rocket is one exotic cardboard box. Rather than burning liquid or solid rocket fuel, VASIMR would use radio waves to heat a stream of ionized gas, or plasma, which would then be expelled at terrific speeds. VASIMR's exhaust nozzle is an electromagnetic field that can change shape to change the rocket's speed. The concept borrows heavily from technology developed through years of research on controlled fusion.

VASIMR's promise is that it could get to Mars in four months, half the time conventional rockets would need. Closer to home, the rocket could recycle waste hydrogen from the International Space Station to keep the lab in orbit without fuel deliveries from Earth. Chang-Díaz calls it a quantum leap in space transportation; "I am very much convinced that this is the way we're going to go to Mars," he says matter-of-factly.

With his passion and charm, the astronaut has convinced a fair number of experts that he's on the right track. Many scientists, though, question whether the rocket will ever get off the ground. Partly out of professional courtesy, and partly for fear of jeopardizing their own NASA funding, those contacted for this article would not attach their names to specific criticism. But the complaints have a common theme: VASIMR continues to win more than its fair share of scarce research money, even though it has yet to produce what critics consider measurable results. One plasma scientist who is intimately familiar with the project goes even further: "VASIMR does not work, even on paper."

Of course, no one is heading to Mars any time soon, so NASA can afford to gamble on ideas that may not ultimately pay off. The agency is putting nearly all its money for advanced space transportation into nuclear-powered ion-drive engines, under the heading of Project Prometheus (see "NASA Goes Nuclear," June/July 2003). Only a pittance—meaning tens of millions of dollars in NASA's $15 billion annual budget—goes to fund far-off, conceptual studies of propulsion methods, which range from solar sails to space elevators to VASIMR.

Chang-Díaz has scraped by for a decade with roughly the same amount of money every year—$1 million, give or take a few hundred thousand dollars. He has gotten some funding from NASA, including the astronaut office, and scrounged the rest wherever he could—the Department of Defense, other government agencies, research foundations, academic collaborators. He has established scientific liaisons with Department of Energy fusion researchers and with international institutions like the Australian National University, the Alfven Laboratory in Sweden, and the Center for High Technology of Costa Rica. John Mankins, who directs a NASA headquarters office called THREADS—Technology for Human/Robotic Exploration and Development of Space—says that perseverance as much as anything explains why the project is still alive: "VASIMR has persisted because Franklin has been a champion of it."

The astronaut's critics agree. They say Chang-Díaz is pursuing what amounts to a government-subsidized hobby. Says one: "It's a big waste of taxpayer money to have all those beautiful toys and no scientific output to speak of."

The output in question is thrust. If VASIMR had produced just a little, the critics say, they might think differently. Chang-Díaz claims that since it would be impractical to put the rocket in a test stand, its thrust is difficult to measure. Nevertheless, his team recently did measure a force of six or seven milli-newtons (about the same thrust that conventional ion drives produce) on a small target placed in the exhaust stream of his prototype engine, presently at the Johnson Space Center in Houston. That ought to be enough for now, he says, to prove that the concept works.

Chang-Díaz had hoped to mount a demonstration on the space station this year to show how VASIMR could be used to boost the station. But a panel of outside peer reviewers concluded that the system wasn't ready for a flight test. So for now, it's back to the lab, where VASIMR has been for nearly 20 years.

After finishing high school in Costa Rica in 1967, Chang-Díaz worked in a bank to help pay his way to the United States. In Hartford, Connecticut, he repeated his senior year to become fluent in the English language, and did well enough in math and science to earn a scholarship to the University of Connecticut. By 1977, the year he received a doctorate in applied plasma physics and fusion technology from the Massachusetts Institute of Technology, he had his U.S. citizenship. Before winning a spot in the astronaut corps three years later, Chang-Díaz worked at the Charles Stark Draper Laboratory in Cambridge, Massachusetts, designing and integrating control systems for fusion reactors.

At Draper he was part of a large team of scientists trying to harness fusion as a peacetime energy source. The quest aimed for nothing less than creating a small sun in the laboratory: confining plasma in a magnetic "bottle" for a long enough period to achieve fusion. As it turned out, the bottle that inspired VASIMR could not be capped tightly enough to make a good nuclear reactor. But Chang-Díaz realized that the technology of fusion also was the tech-

charm to prove that plasma rockets are the way of the future.

BY BETH DICKEY

DAVID NANCE

Opposite: The astronaut and his invention. Because space has gravitational hills and valleys, the rocket gears up and down as needed.

NASA

For his last shuttle flight, Chang-Díaz trained in virtual reality.

nology of plasma propulsion and set out to bring the two together. If the fusion chamber was leaky, why not use the leaking plasma for thrust, the way an untied balloon zips around the room if you let it go?

After joining NASA's shuttle corps as a mission specialist, the astronaut continued his propulsion research through assistants at MIT. He squeezed in occasional lab visits between training commitments for his shuttle flights. But science in absentia finally lost its appeal. In 1993 Chang-Díaz moved VASIMR to the Johnson Space Center, whose director provided funds for a new Advanced Space Propulsion Laboratory, with the astronaut as director. Ten years later, Chang-Díaz and a team of scientists and engineers continue to work on a prototype called VX-10.

The contraption brings to mind Jules Verne or H.G. Wells. It consists of a linked series of clanking, puffing metal cylinders outfitted with hoses, tubes, valves, and dials. Through little round windows in the cylinders, the experimenters watch the colorful glow of ionized gas conforming to a nozzle shape as it streams past a series of liquid-nitrogen-cooled copper-coil magnets (the real thing will use superconducting magnets). Chang-Díaz likes to joke that when the VX-10 runs, the lights flicker.

Rockets produce thrust by shooting hot gas through a nozzle at very high speed. The hotter the material is, the faster it exits, and the better the rocket performs. A faster exhaust also cuts propellant consumption. Conventional rockets have limited room for improvement in this area, because increasing the exhaust velocity increases the danger of engine meltdown. VASIMR solves the problem by eliminating parts—such as electrodes for heating the gas—that can melt. Instead, the gas is heated by radio energy, much the way microwaves bring water to a boil.

In the VX-10 test chamber, the forward cell ionizes—electrically charges—the gas so that it stays confined in a magnetic field. The center cell then bombards the plasma with radio waves, heating it to one million degrees, and the aft cell converts the superheated plasma's energy to rocket exhaust (see "Heat Waves," opposite).

VASIMR produces much higher exhaust velocities than conventional ion-drive engines, and more mass can be expelled. The rocket, therefore, can produce much greater thrust. And because the shape of the magnetic nozzle can change, the thrust is variable, one of VASIMR's big advantages. Chang-Díaz, a Corvette enthusiast, designed the rocket to cross the gravitational hills and valleys of space the way an automobile shifts gears to cross a mountain range. For the cruise to Mars, low thrust—expelling less mass at high exhaust velocity—saves fuel. Higher thrust would be used for entering or exiting a planet's gravity "well."

First, though, the VASIMR team has to solve several knotty problems. The plasma tends to cling to the magnetic field that confines it, and for the rocket to go anywhere, it has to detach before exiting the nozzle. Detachment happens in nature: The sun spits out plasma in the form of solar flares. But in laboratories, it has been virtually impossible to demonstrate. VASIMR's critics are convinced the detachment problem is a showstopper. Chang-Díaz is equally confident that "in time, this will be shown to be a non-issue." Sensitive to the criticism, however, he has engaged U.S. and Swedish collaborators in experiments to demonstrate detachment. But he cautions that obtaining conclusive results may require investing in a larger and more expensive test chamber.

ADVANCED SPACE PROPULSION LABORATORY/NASA JOHNSON SPACE CENTER

What looks like steam coming from the VX-10 test chamber is actually venting of the liquid nitrogen used to cool the giant magnets that confine the plasma. Gas is injected through a tube on the right side and comes out as exhaust at left, beyond the frame of the picture. Windows and diagnostic probes are used to monitor the behavior of the plasma.

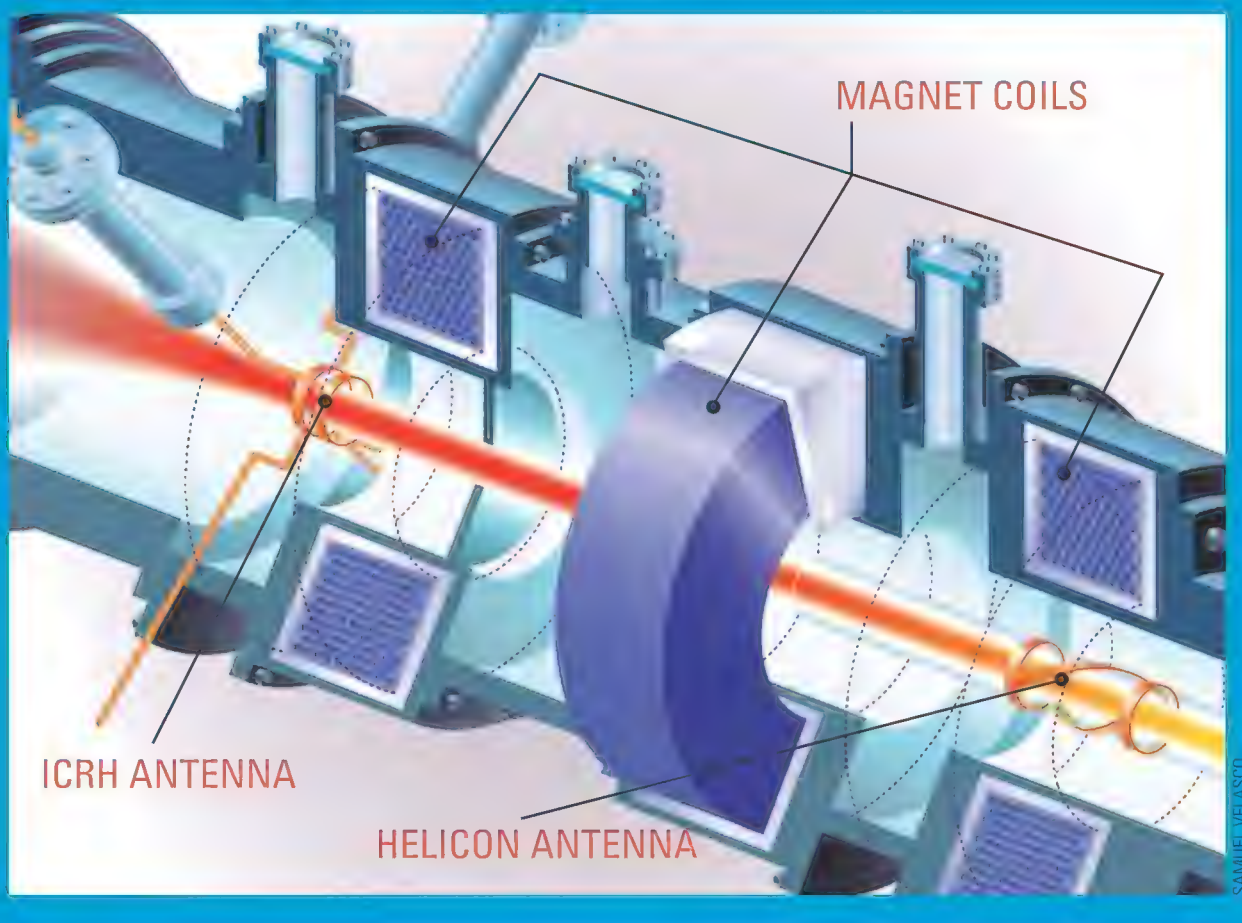
The space shuttle main engine, the best chemical rocket in use today, has a specific impulse—a measure of fuel efficiency—of 465 seconds. Recently, the VX-10 achieved a specific impulse of 11,000 seconds, using deuterium, or heavy hydrogen, as fuel.

Some of VASIMR's critics say heavier elements would give even better results. The peer reviewers suggested lithium, which has been used in low-thrust plasma propulsion experiments at NASA's Jet Propulsion Laboratory in Pasadena, California. Chang-Díaz is reluctant, because lithium is highly toxic and could pose a contamination hazard in space. The team has experimented with argon, helium, and xenon, among other propellants, and plans to try ammonia. Chang-Díaz originally chose hydrogen and deuterium for several reasons. Both can be stored at cryogenic temperatures, meaning they can be used as propellant as well as coolant for the magnets that confine the plasma. They also are among the most abundant elements in the universe, so space travelers would find ample supplies anywhere they go.

In 2002, with NASA planners for the first time in years discussing trips beyond Earth orbit, agency managers requested the "non-advocate" peer review to assess VASIMR's readiness. It came just as the project was experiencing its closest brush with death. By the time Chang-Díaz returned that June from his seventh space shuttle mission, STS-111, his rocket was within four months of cancellation. "Unless Franklin is successful in wooing money," NASA's Space Architect Gary Martin said at the time, "the project goes dark in October." NASA was scraping for cash to cover a multibillion-dollar overrun on the space station, and the aerospace technology and space transportation accounts that had contributed money to VASIMR in the past were now tapped out. Even the astronaut office was holding back about $200,000 in discretionary funds it had once promised to the project. NASA tried unsuccessfully to interest the defense department in taking VASIMR off its hands, and scheduled the peer review, which was completed in November.

According to John Mankins, the reviewers were "tentative" but willing to grant VASIMR a few years' lease on life. He says they wanted to know more about the fundamental physics and how the elements of the rocket would work together as a system. The panel recommended further study, and NASA shifted the project to a new directorate for space and astromaterials research and exploration, making it eligible for what Mankins describes as "moderate" funding. "It's on the order of $2 million a year for a while," he says, "something that can keep the steam heated, definitely." VASIMR also will benefit from three NASA small-business research grants worth a total of $740,000, which will go for technologies like the superconducting magnets to be used in a next-generation prototype.

Propulsion concepts come and go, but VASIMR has shown staying power. "Oftentimes, I think of this project as one of the weeds you try to kill in your garden," says Chang-Díaz. "It won't die, and every time you try to kill it, it grows bigger and stronger." Mankins takes a "let's see how this develops" attitude. "If the physics turns out to really work, it is so cool," he says. "But even if it turns out VASIMR is not the right answer, it seems to me some kind of plasma propulsion has to be an option for the long term." Chang-Díaz, the dreamer turned astronaut turned rocket builder, knows a lot about long-term planning. And patience.



SAMUEL VELASCO

Heat Waves

Unlike other plasma propulsion concepts, VASIMR uses no electrodes to heat its propellant. Instead, antennas generate radio waves, which heat the plasma to a high state of excitation. In the first stage, a helicon antenna designed by Australian National University researcher Rod Boswell ionizes the gas, which is confined by magnetic coils surrounding the chamber. The plasma is "cold"—more than 100,000 degrees Fahrenheit—when it enters the second stage. There, an ion cyclotron resonance heater (ICRH) antenna, similar to the kind used in fusion research, adds more radio energy to get the plasma cooking at much hotter temperatures. When it is hot enough to provide thrust—a million degrees or so—it enters the inlet of the magnetic nozzle, which shapes the flow further as it exits.

by Derek Grzelewski

AUSTRALIAN RACING moths

Dispatches from an air race that is more fun than fast.

It is 6:30 a.m., but the camp on the edge of the Maitland aerodrome, a hundred miles north of Sydney, is already buzzing. The camp is composed of two long rows of military tents, 40 total, and outside each, parked tail to the entrance, stands the subject of much fussing: a restored, shiny, flyable de Havilland 82A Tiger Moth. Men and women in green flightsuits mill around them, wiping dew off the wings, stowing cockpit and propeller covers, mopping up leaked oil. The sky is clear blue, the windsock hangs limp, and as they work, the pilots greet each other cheerfully. It's a perfect day to race Moths.

Inaugurated in 1977, the Great Australian Tiger Moth Air Race attracts competitors from around the country, even from Perth, on the opposite coast of Australia. The entrants come from all manner of aviation backgrounds: high-time airline pilots, flight and aerobatics instructors, air force fliers. One owner, farmer Geoffrey Wills of Lake McLaren, Victoria, has had the same Tiger Moth for 38 years; another, Barry Markham of Perth, once flew his Tiger, VH-NOV, from Perth to London in a 60-day re-creation of one of the pioneer flights made to show how air travel could connect major parts of the British Empire.

"After I'd retired from the air force, I tried a lot of things: aerobatics, jet skis, a Harley—but nothing worked," says Vaughan "Bud" Felton, who once served as a flight instructor for the South African air force. "Then I flew a Moth and within four days I owned one. It is a fantastic challenge to fly—and besides," he adds, caressing the yellow fabric-covered wing of his aircraft, "it's an absolute and pure indulgence."

Once you've been converted, he says, deplaning from a Moth leaves "a huge hole in your life."

The Tiger is one of a long line of Moths, graceful light aircraft hatched in the fertile imagination of Geoffrey de Havilland, a British aircraft designer and amateur entomologist. In 1925 he brought out the Cirrus Moth, which became the first trainer for government-sponsored flying clubs. The Cirrus evolved into the Gipsy, and the Gipsy into the Tiger, which was easier for military airmen to enter and exit. The Tiger had a service ceiling of 14,000 feet, a 300-mile range, and a 130-horsepower Gipsy Major engine that gave the craft the capability of speeds up to 85 to 90 mph. And at £830 apiece (about $3,770 in 1931, the year the Tiger first flew) and operation costs of under £1 an hour, the Tiger was a hit with private owners and aero clubs alike.

During World War II, the Tiger was used to train pilots to fly for Commonwealth air forces—Britain, Australia, New Zealand, Canada. The aircraft was well suited for teaching: It seemed to magnify piloting errors, but because it was slow to respond to control inputs, it permitted students to fix errors before getting into trouble. Russ Evans, who learned to fly in a Tiger Moth in 1938 and is competing in today's race, has another explanation: "The idea for using them as trainers was that if a pilot could fly a Tiger, he could fly just about anything."

Another Tiger idiosyncrasy is that in its original version it did not have a tail wheel but a skid—a palm-size cast-iron hoof for stopping the airplane on an aerodrome's slick grass. (The first Tigers, operating mostly from grass strips, had no brakes.) Today, of all the Tiger Moths gathered at Maitland, only one, Geoffrey Wills', sports a tailskid; others have been upgraded with tail wheels and brakes so that they can operate on paved runways.

OPPOSITE: CRAIG JUSTO; RIGHT: GLENN ALDERTON

CRAIG JUSTO (3)

John Cameron finishes the race, unaware that he's just placed first.

Their aircraft cleaned up and ready to go, the pilots fasten their leather helmets and tighten the straps on their brass-frame goggles. They line up their Tigers into a snaking procession, revving to get airborne, staggered in one-minute intervals. "Go fast!" shouts a well-wisher, but a fellow observer explains that exactly the opposite is needed: The competitors' time is offset by fuel consumption. Everyone starts out with the same amount of fuel. If, over the two days of the race, a pilot's fuel usage averages more than 33 liters (8.56 gallons) an hour, his or her time is penalized 10 minutes. The offset encourages flying modes that save on fuel, like straight-and-level flight. (Chief race "scrutineer"—official—Lance Fletcher, who wrote the race rules, included other penalty-incurring infractions, such as flying below 500 feet, neglecting to fly over a race ground marker, and flying over a ground marker in the wrong direction.)

Despite all the rules, it's not a fierce race. Says Russ Evans, all you need is "a full tank and a good sense of humor."

Out of a shaded stage, where a brass band will later play, Nancy Bird Walton, Australia's oldest pilot, watches as each Tiger takes off for the first leg of the race, a 150-mile circuit of the beaches to the north. Bird Walton learned to fly in 1933—in a Tiger, of course—under the instruction of Charles Kingsford Smith, Australia's greatest aeronautical icon. (He made the first crossing of the Pacific and eventually held more long-distance records than any other pilot.) Bird Walton recalls Kingsford Smith teaching her some practical skills: "In emergency landings, we were to always head for the trees, and aim the plane between the trunks," she says, "the idea being that the wings would break off and slow you down."

Fortunately, the strategy is not needed when the racers return in the afternoon—tired, dusty, elated. But then a storm erupts, threatening hail, which could damage the fabric covering the spruce wings. Those who haven't landed leave the area. Even a few who have landed take off in search of shelter for their Tigers. Many find it only two minutes away, in the hangars at the Luskintyre Aviation Museum. For some of them it's like coming home.

Timekeepers (in orange) document takeoff details.

Roy Whitford gets a kick out of his mock high-tech instrument panel.

More than half of the Moths racing at Maitland had been reborn at the Luskintyre museum—some more than once—undergoing lengthy restorations in the workshop of Ray Windred. On the walls are skeletal drawings—wing spars, ribs—and parked around are about a dozen aircraft in various stages of reconstruction, from bare bones to flyable.

Twelve years ago Windred heard that a long-neglected Western Australia hangar housed a treasure trove: a collection of 19 Tiger Moths that had fallen into total disrepair. Windred bought the lot for around $170,000. The seller, a Moth buff who had once used the entire fleet for crop-dusting, put one stipulation on the sale: The aircraft could not be sold off for parts or profit but could only be sold restored. Windred agreed. He had long been a mechanic, working on vintage cars and motorcycles, and when he'd gotten into flying, he learned aircraft restoration by working on Moths. As for his obligation to the seller, "every so often I send him a picture of another Moth, good as brand-new, being wheeled onto the runway," he says. "I only have three more to go." Windred needs 12 to 18 months to fully restore a Tiger, and the buyer can pay up to $80,000.

BELOW: CRAIG JUSTO; RIGHT: GLENN ALDERTON

Pilot Sabine Pfisterer and navigator Neal Hawadine return from the first leg. The weather will stay damp and gusty.

Day two begins with a steady downpour. The competitors sit in their cockpits, squinting into the rain pelting their helmets and goggles. Braving discomfort seems a part of the Moth experience. Referring to the seats, entrant Muray Lanyon says: "The aircraft takes enough fuel for about two and a half hours of flight. That's about an hour longer than you would want to sit in it."

In quick succession, the racers take off and this time head toward the south, forming a garland. Only minutes into the flight, the weather clears and the fliers enjoy glorious sunshine and stunning views, flying low enough to identify the ground markers they must overfly in order to complete the race circuit.

During World War II, pilots training in Australia would fly their Tiger Moths over Sydney Harbour, and today, the racers salute the veterans by flying over the Harbour Bridge. As they head along Sydney's beaches, spectators there crane their necks to follow the Tigers avidly.

By 2 p.m., all 40 Tigers are back in Maitland. The judges have noted the flight times, as well as opened each Moth's gas tank to measure the fuel remaining. It's eventually determined that John Cameron and David Theiss, flying VH-AJA, place first, at 3:51:58 and a fuel burn of 29.7 liters per hour. A close second goes to Frank Williams with his grandson, Andrew Biggs, navigating (3:53:26; 31 liters). In all, 10 aircraft were slapped with penalties, ranging from 10 to 40 minutes.

The announcements are followed by a traditional Australian barbecue. In the evening, the race's sponsor, Airbus, holds a 1930s-theme party (the decade of the Tiger's debut), complete with a 19-piece swing band, that brings in 250 guests, some dressed in '30s flightsuits. Nancy Bird Walton bestows more awards: best score for a two-Tiger team from each Australian state, best-restored Tiger, oldest pilot, youngest pilot…

Soon after, the racers head home, though for some, like the five who have to cross the entire country to return to Western Australia, more adventures await. At a remote desert gas station, the wind grows so strong it takes three team members to steady each aircraft during refueling. "Flying Tigers is a lot like sailing," team member Mick Harcourt tells me later. At one point, when the wind turns 180 degrees, "our ground speed was 14 mph," Harcourt says.

The total trip takes six days—a "sore butt" exercise—but Harcourt explains that you make it by toughening up and focusing on the scenery. And as much fun as the race and the camaraderie had been, taking in the vast expanse of the stark, mysterious Outback, at what the team discreetly referred to as "an undisclosed altitude," must have been grand indeed.

SIGHTINGS

"Black-and-white is timeless," says Roger Tonry, explaining why much of his photography is not in color. "These shots were taken present-day, but that certainly isn't the viewer's first impression." Indeed, the images here evoke a sense of the past, and perhaps a feeling of loneliness.

Many southern Californians with pilot's licenses will wax nostalgic over the photo of Meadowlark Airport's office (below). Originally called Sunset Beach, the airport got its first paved runway in 1963—all 1,800 feet of it. Meadowlark regulars dined at the Café—a half-dozen picnic tables right under the departure path. One devotee held his wedding ceremony at the windsock. Tonry took this picture in 1984; five years later, Meadowlark closed down. "People compliment me on how I arranged this shot, but that's how it sat when I walked up," he says.

The photo of a seemingly abandoned Corsair (opposite, top) "looks like it was taken on a Pacific island," Tonry says, "but it was sitting in a field alongside a runway at Chino Airport," also in California. And the Corsair is right at home, for Chino boasts three museums devoted to classic aircraft: Planes of Fame, which includes the National Air Race Museum, and Yanks Air.

With the mixed bag of air traffic at Chino, air traffic controllers learn patience and tolerance, which they extended to Tonry when they allowed him to put an artificial Christmas tree in their tower (opposite, bottom)—in April. "They explained it to the pilots who asked about it while cautioning them to avoid the photographer standing in the taxiway, waiting for the sun to go down," Tonry says.

Fast Flying, Faster Living

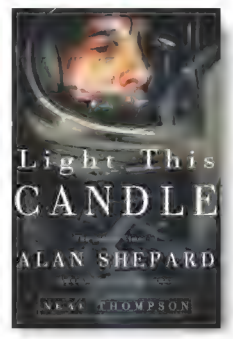
Light This Candle: The Life and Times of Alan Shepard, America's First Spaceman

by Neal Thompson. Crown Publishers, 2004. 436 pp., $27.50.

In 1979 Tom Wolfe pounded the first nail into the coffin of the BSA myth (that's Boy Scout Astronaut) with his book *The Right Stuff*. Consider *Light This Candle* another nail. Wolfe set a precedent by reporting that some of the seven Mercury astronauts, certainly including Shepard, fell far short of the way they were sold to the world by NASA image-makers. One famous scene in the book and the film has John Glenn—"Mr. Clean Marine"—admonishing the other astronauts to keep their pants zipped, an allusion to flagrant womanizing. The incident leading to that nasty confrontation, as described by Neal Thompson, occurred when flashbulbs went off while one of the seven was entertaining a senorita in Tijuana. The transgressor, later identified as Shepard, appealed to Glenn for help, and Glenn, in turn, had to beg what this book calls "a leading West Coast paper" on patriotic grounds not to run the story. It didn't. The news media knew about many of the Mercury astronauts' indiscretions, but they ignored them. The cold war was on, and as Walter Cronkite said, "The country needed heroes."

COURTESY: SHEPARD FAMILY /NASA

To shuttle between astronaut training sessions at NASA centers, Alan Shepard frequently flew a T-38. He logged 3,700 hours in jet aircraft during his career.



Shepard said he hated *The Right Stuff* and quipped that his and Deke Slayton's own sanitized history of the Apollo Program, *Moon Shot*, should have been titled *The Real Stuff*, "since his [Wolfe's book] was just fiction." Well, maybe *The Gruff Stuff*.

After Shepard's death in 1998, Thompson, a veteran journalist, gained exclusive access to Shepard's papers and interviewed his family and fellow astronauts. His material shows that Shepard was an immensely complicated and conflicted man whose many passions drove him to feats of extraordinary bravery and accomplishment, but also to dangerous flirtations with self-destruction. Shepard was the scion of a New Hampshire family that went back to the *Mayflower*, and grew up to become the sort of maverick for which the New England upper crust is renowned. His father's wish that he go into the Army sent him directly to the Naval Academy in Annapolis, where he was nearly expelled twice, and then to Corpus Christi, Texas and Pensacola, Florida flight schools, where he realized a boyhood dream of becoming an aviator.

MUSEUM COLLECTIBLE

America's Hangar: Smithsonian National Air and Space Museum Steven F. Udvar-Hazy Center

by the staff of the National Air and Space Museum, 2003. 72 pp., $14.

This first souvenir book for the Steven F. Udvar-Hazy Center is filled with tack-sharp photography depicting some of the center's 200 aircraft and spacecraft, as well as rockets, missiles, and other artifacts on display there. Also included are photo-essays about the journey of the Boeing B-29 *Enola Gay*'s fuselage to a restoration facility and then to the museum via the streets of Washington, D.C., and the construction of the Udvar-Hazy Center's observation tower and three-football-fields-long hangar.

He turned out to be a brilliant, instinctive flier who loved landing on pitching carriers at night, and who went on to defy death by testing high-performance jets at the Naval Test Pilot School at Patuxent River, Maryland. Flying brought out Shepard's mercurial nature. One minute he was the cool, calculating aerodynamicist in the cockpit. The next he was roaring so low—"flat-hatting"—in his F2H Banshee that hundreds of sailors standing at attention had to dive for cover. The latter incident nearly led to a court-martial. Another time he did a complete loop under and over the uncompleted Chesapeake Bay Bridge. And in an effort to put fighter pilots in the proper mindset when steering their fuel probes during aerial refueling, he painted pubic hair on tanker drogues.

Shepard's ambition and tenacity were legendary. He assured his place as the first American in space by going to a private physician for an experimental operation that cured a severe balance problem. He also used adroit politics to out-maneuver six competitors for the honor. And he stayed in the astronaut program long enough to eventually get to the moon on Apollo 14.

And, yes, he did love comedian Bill Dana's character José Jiménez, the Latino astronaut. He did urinate in the Mercury Redstone capsule, reporting in José's dialect, "I'm a wetback now." And on May 5, 1961, exasperated by the long delay launching *Freedom 7*, he really did bark at the mission controllers: "I'm cooler than you are. Why don't you fix your little problem and light this candle?"
—William E. Burrows, the author of This New Ocean, *is an* Air & Space/ Smithsonian *contributing editor.*

BOOK BITES

Spirit and Creator: The Mysterious Man Behind Lindbergh's Flight to Paris

by Nova Hall. ATN Publishing, 2003. 184 pp., $39.95.

Four years ago, Nova Hall discovered an old locked chest in the family garage. Within it was his grandfather Donald's collection of photos, documents, design tools, movie footage, aircraft models, and correspondence with Charles Lindbergh, for whom Donald Hall had designed the *Spirit of St. Louis*. *Spirit and Creator* is an inside look at the creation of the legendary Ryan monoplane and the man who, at Lindbergh's side, first sketched it out and saw it through to completion.

—Patricia Trenner

The Flying Book: Everything You've Ever Wondered About Flying

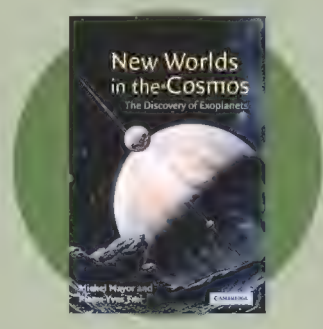
by David Blatner. Walker Publishing, 2003. 248 pp., $22.

If you've ever wondered why your flight route never runs in a straight line, or why pulling away from the terminal makes your airplane's cabin lights flicker, you can find the answer in *The Flying Book*. A multitude of pictures, subheadings, and pullouts make it easy to learn practically everything about the history and inner workings of commercial air travel. Readers learn how technological advances have led to water-efficient airplane toilets and why the wings of a 747 are designed to bend up to 10 feet up or down during flight. While thorough, *The Flying Book* does at times slide off-topic; one section focuses on why news media report airplane crashes but not successes in airplane safety; another describes the physics behind insect flight. Still, David Blatner weaves history, techno-babble, and quirky fact into a complete and fun book.

—Theodore Carter

New Worlds in the Cosmos: The Discovery of Exoplanets

by Michel Mayor and Pierre-Yves Frei. Cambridge, 2003. 248 pp., $30.



Michel Mayor, co-discoverer of the first planet outside the solar system, and science writer Pierre-Yves Frei walk the reader through mankind's views about the universe from early civilizations to the potential contributions of still-distant technologies. Mayor is a connoisseur of astrometrical techniques, able to deftly describe the centuries of layered cleverness that ultimately led to his and Didier Queloz's detection of planet 51-Peg b in 1995 and the nearly 100 planets found by others since. While the authors have written clearly and engagingly about a difficult subject's obstacles and epiphanies, *New Worlds* may be best appreciated by those with a more-than-casual knowledge of astronomy or physics.

—Sam Goldberg

Fire Flight

by John J. Nance. Simon & Schuster, 2003. 353 pp., $25.

Aviation safety advocate John J. Nance is best known as a writer of thrillers, two of which, *Pandora's Clock* and *Medusa's Child*, became television mini-series. His newest effort, *Fire Flight*, traces the tribulations of a group of flying and parachuting firefighters charged with preventing a major forest fire from destroying Jackson, Wyoming, and environs.

The action unfolds over three days, during which we meet a collection of comic-strip-like heroes who fight fires and the forces of evil with equal vigor. Nance defines evil as having two heads. One advocates extinguishing forest fires rather than letting them burn out, a procedure that has infected forests with a carpet of low-lying tinder and kindling waiting to erupt. Evil's other head is personified by independent firefighting contractors who use decades-old aircraft that don't always work properly and put courageous crews at risk.

To end a fire that threatens both natural resources and overpriced real estate, intrepid pilot Clark Maxwell, smokejumper Karen Jones, conniving fleet operator/media controller/banking controller Jerry Stein, Stein's volatile maintenance boss (who does double duty as Karen's abusive husband), and a host of others work at cross-purposes.

Fire Flight's numerous subplots and personalities make *War and Peace* seem like minimalist literature, and the novel's adventure highlight, involving a Beechcraft Baron pilot flying upside down with a broken wing, is resolved in a manner that, by comparison, reduces the parting of the Red Sea to the level of a card trick.

The characters march bravely through one crisis after another, teetering on the wrong edge of believability. Too many of the bad guys turn out in the end to be okay, though one of these was so obnoxious this reader prayed for him to go up in flames along with his towering and tacky house.

Nance, a 13,000-hour military and commercial pilot, is on firm ground when he takes us inside a variety of aircraft and into the air under terrible conditions. He makes a compelling case for establishing a

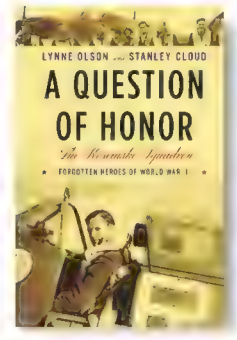
government-operated fleet of modern aircraft, but it is a pity that he does so with characters whose dimensions range from one to two.

—William Jeanes, a contributing editor for AutoWeek *and a former editor-in-chief of* Car and Driver, *lives in Pass Christian, Mississippi.*

A Question of Honor

by Lynne Olsen and Stanley Cloud. Alfred A. Knopf, 2003. 542 pp., $27.95.

The husband-and-wife team of Lynne Olsen and Stanley Cloud have written an excellent and highly readable book on the little-known but major role of the Polish armed forces, especially pilots, during World War II. Drawing on official documents, histories, memoirs, and interviews with former members of the Kociuszko Squadron (which was formed by a U.S. World War I fighter pilot in 1919 to help Poland defeat the Soviets in a border war, and evolved into an elite unit that was strongly pro-America), the authors trace the lives of five charismatic fighter pilots: Squadron Commander Major Zdzislaw Krasnodíbski, pilots Miroslaw Feriâ, Witold Lokuciewski, and Jan Zumbach, and Polish Air Force Academy instructor Captain Witold Urbanowicz, who would eventually form the nucleus of one of the United Kingdom's Royal Air Force fighter squadrons in England.



After the collapse of Poland, we follow the Polish pilots' harrowing escapes from the Germans, first to France, where they fought a losing battle against the invading Germans, and then to England, where the British bureaucracy fumbled in using their experience. This was at a low point in the days following the evacuation of the beleaguered British Expeditionary Forces from the beaches of Dunkirk. The Royal Air Force had suffered huge losses, in both men and equipment, in the abortive effort to stem the invasion of France and the Low Countries, and it was clear to the British that the battle for Britain was about to begin. In light of the pending attack, the RAF decided to give the Poles a chance to demonstrate their abilities. With minimal training in the Hawker Hurricane—then the mainstay of RAF fighter units—the Poles scored the highest number of kills of any squadron and became recognized as heroes of the Battle of Britain.

But while the Poles were fighting valiantly to save Britain, and ultimately to liberate their homeland, Churchill and Roosevelt were making secret deals with Stalin, a brutal betrayal that resulted in all of eastern Europe given over to Soviet occupation. Much of the second half of the book deals with the politics of the betrayal, and events through the end of the war and into the post-war Communist era.

Of the thousands of Polish soldiers who survived the war, less than one in five returned to Poland; most chose exile. The only Kociuszko pilot to return was Witold Lokuciewski, who joined the Polish air force again in 1956, rose to the rank of colonel, and became an attaché in London, where he was snubbed by many of his old friends, who felt he had sold out to the Communists.

Olsen and Cloud have given us a comprehensive tour of Poland starting in 1939, and have kept the telling tight and interesting. For a historical reference this book will be invaluable. The notes, bibliography, and photos are plentiful and comprehensive. I would like to have seen another map or two showing the RAF airfields during the Battle of Britain, but even so, this is a compelling book.

—Lieutenant Colonel Bob Hanson, U.S. Air Force (ret.), flew combat missions in F-4Es during the Vietnam War.

Beyond: Visions of the Interplanetary Probes

by Michael Benson. Harry N. Abrams, Inc., 2003. 321 pp., $55.

Looming on our left from the gloom of space, asteroid Eros tumbles slowly toward us—a pitted, 21-mile-long chunk of interplanetary debris. The NEAR space probe transmitted this unnerving photographic sequence early in 2000. Consider, too, Galileo's unprecedented 1998 close-up of asteroid Ida and its tiny moon, Dactyl, and you'll gain a sense of this stunning volume's unusual photos, taken by all kinds of probes, from early Lunar Orbiters to the Cassini probe headed for a Saturn rendezvous this July 1.

Michael Benson, a photographer, filmmaker, and writer, blends individual archival NASA photos into seamless mosaics. He has teamed with noted art book publisher Harry N. Abrams to create a triumph of graphic design, in which dramatic photographs and white text float on a black background, propelling readers into aesthetic proximity with the planets he describes. Io and Europa—moons of fire

and ice—orbit over orange and ochre whorls of Jupiter's bands. When the camera angle is shifted, Europa, with its arcing ice ridges, hovers like a veined eyeball. From sulfur-yellow Io, the Pele volcano emits massive gas plumes that arc across the black void like blue solar prominences.

Benson's text traces how cold war intercontinental ballistic missile booster rockets evolved into the launchers used to deploy Voyager, Venera, Mariner, and Cassini. And he knows his planetology. Although cratered Mercury may resemble our moon, Benson reminds us it is denser, 40 percent larger, endowed with a magnetic field, and owns the solar system's only other molten core besides Earth's. And he makes sure we know that Saturn's satellite Titan is the solar system's only moon with a "substantial atmosphere."

In a foreword, Arthur C. Clarke extols the continuing evolution of humankind's increasingly intricate and intelligent machines. Former *New Yorker* political and cultural reporter Lawrence Weschler argues in his afterword that such "whirring gadgetry" lacks the human sense of marvel and wonder that should emerge from any close encounter with this volume of images. Both, of course, are right.
—Lee Gaillard writes on defense issues and military technology for Defense News, *the* San Francisco Chronicle, San Diego Union-Tribune, Philadelphia Inquirer, *and* Naval Institute Proceedings.

NEW SOFTWARE

Redshift 5

Viva Astronomy, 2003. Available from *www.viva-media.com*; $59.99. *Redshift 5* is a good attempt to win over those doubtful of sometimes-difficult desktop planetarium software. Create sky maps, track the Mars Express spacecraft as it creeps toward the Red Planet, or witness an animated sunrise on Mercury with the new "guided tours" function. *Redshift 5* boasts impressive numbers—its database contains 20 million stars and 70,000 deep-space objects, along with moons, asteroids, and planets. Beginners may find *Redshift 5*'s glossy interface challenging to navigate, and guided tours show off its crisp graphics but won't help you design your own tours any more than listening to Beethoven's Fifth would teach you to play the cello. Still, though most users will access only a fraction of this digital cosmos, its richness energizes every mouse click with the thrill of exploration.
—Kate Becker

Redline Xtreme Air Racing 2

Encore, 2003. Available from *www.encoresoftware.com*, $29.99. The premise of Redline Xtreme Air Racing 2 is simple: Race a fast airplane around a low-level circuit. The game re-creates the excitement of trying to squeeze a little more horsepower out of an overheating engine or picking the best racing line to sneak into first place with real-world airplanes (including National Air Races 2003 Unlimited Champion *Dago Red*, a souped-up P-51 Mustang). While *Redline 2* is fun, it is not polished. The airplanes are better modeled than the so-so scenery, but the graphics saunter rather than sprint. If you own the previous version, it may not be worth upgrading; this sequel is a case of more rather than better. For the newcomer, despite its defects, *Redline 2* does a good job of making races come to life and is an exciting alternative to the more traditional flight simulations or air combat games.
—Matthew Stibbe

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For back issues, visit the Web at *www.airspacemag.com/asm/mag/index/backissues.html* or send a check for $7.00 ($9.50 international), payable to the Smithsonian Institution, to *Air & Space*, P.O. Box 37012, Victor Bldg., Suite 7100, MRC 951, Washington, DC 20013-7012

Not every issue of the magazine is available.

CALENDAR

February 26
Guest speaker series: Tuskegee Airmen. In celebration of Black History Month, come meet Tuskegee airmen and listen to their stories about their military service during World War II. Virginia Aviation Museum, Richmond International Airport, VA, (804) 236-3622, *vam.smv.org*, 7 p.m.

February 28
"A Remembrance of War" Seminar Series: "A Military Life." Colonel Bruce Wallace (U.S. Army, ret.) discusses his 33-year military career, from B-17 gunner to service in the Pentagon and with the Joint Chiefs. American Airpower Heritage Museum, Commemorative Air Force Headquarters, Midland, TX, (432) 563-1000, ext. 2259, 2 p.m.

March 18
Guest speaker series: William A. Guenon Jr. gives an eyewitness account of an attempt to rescue prisoners of war during the Vietnam War. Afterward, he will autograph copies of his book, *Secret and Dangerous: Night of the So'N Tay POW Raid*. Virginia Aviation Museum, Richmond International Airport, VA, (804) 236-3622, *vam.smv.org*, 7 p.m.

March 19 & 20
Memphis Belle: An evening gala and afternoon seminar, featuring a discussion with Colonel Robert Morgan, pilot of the famous World War II Boeing B-17. Commemorative Air Force Hangar, Midland International Airport, Midland, TX, (432) 563-1000, ext. 2259.

March 20
Ultralight Safety Seminar. Learn about safety techniques, maintenance, and other factors in flying ultralights. Virginia Aviation Museum, Richmond International Airport, VA, (804) 236-3637.

March 24–27
National Congress on Aviation and Space Education: "Teaching Today for Tomorrow." Sponsored by the Civil Air Patrol and the U.S. Air Force, this conference will focus on preparing students for aerospace industry careers. Atlanta Marriott Marquis, GA, (334) 953-5320, *www.capnhq.gov*.

Organizations wishing to have events published in Calendar should fax press releases two months in advance to (202) 275-1886 or mail them to Calendar, Air & Space/Smithsonian, *MRC 951, P.O. Box 37012, Washington, DC 20013-7012.*

CREDITS

Cover. Photographer John Dibbs' subjects range from historic and modern military aircraft to commercial airliners. He specializes in air-to-air photography, and over the last 10 years he has flown in more than 120 types of aircraft, shot more than 800 sorties, and authored 10 books, including the Flying Legends series of books and calendars.

Leave It to the Beaver. Elswick Newport evacuated 1,187 Korean War patients during his 13-month tour as commander of a helicopter ambulance detachment.

The Education of a Ramp Rat. Airline captain Kevin Garrison lives in Kentucky, where he raises Norwegian fjord ponies and generally loses at tennis.

Glacier Girl. Carl Hoffman is the author of *Hunting Warbirds: The Obsessive Quest for the Lost Aircraft of World War II* and a frequent contributor to *Air & Space/Smithsonian*.

The Other Moon Landings. Science journalist Andrew Chaikin wishes he could follow in the Lunokhods' footsteps. He watches the moon from his home in southern Vermont.

Reflecting the Glow of Flight's Golden Age. Diane Tedeschi is an associate editor at *Air & Space/Smithsonian*.

The People and Planes of Santa Paula. Marshall Lumsden is a retired magazine editor who lives in Malibu, California. His last contribution to the magazine recalled his experience as a fighter pilot with the U.S. Army Air Forces' 315th Fighter Squadron ("The Invasion of Manchester," Dec. 2003/Jan. 2004).

Peter McBride is a Colorado-based photographer who frequently works for *National Geographic*, *Smithsonian*, *Outside*, and many other publications. Having grown up in a family of bush pilots, Peter loves low and slow flying.

French Lessons. Janelle Dupont is a freelance writer in Austin, Texas. She is writing a book on the U.S.-French pilot training program.

How Things Work: Electro-mechanical Deicing. Tim Wright is a writer and photographer based in Richmond, Virginia. His last article for *Air & Space* was "Giant Amphibian" (Dec. 2002/Jan. 2003).

Star Power. Beth Dickey is an *Air & Space* contributing editor.

Australian Racing Moths. Freelance writer and amateur pilot Derek Grzelewski is a frequent contributor to *Smithsonian* magazine. He lives in the New Zealand town that hosts the Warbirds Over Wanaka airshow.

FORECAST

In the Wings...

Night Stalker

You won't find the QT-2 in books on Vietnam-era aircraft. Built in secret and quiet as a ghost, it was flown to spy on Viet Cong, who didn't know they were being watched till the gunships showed up.

COURTESY LES HORN

Maintainers worked each day to ready the QT-2 for its mission each night.

"I Got Shot Down"

Tales of terror and survival.

Special Report: Electromagnetic Interference

What is it about cell phones that drives airline pilots crazy?

Bullseye!

Impact craters are easy to see on the pocked surface of the moon, but where on Earth are they?

SPECIAL SECTION: AIRSHOWS '04!

The Joy of the Small Airshow

Who needs the Blue Angels?

Airshow Sideshows

Every carnival has its freaks.

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COURTESY USAF MUSEUM

Convair's F-102A Delta Dagger

Order back issues, watch our stock of videos, find links to other hot aerospace sites, and learn about the other delta-wing aircraft that were contemporaries of the Avro Vulcan, featured in the Dec. 2003/ Jan. 2004 issue.

COURTESY MAYNARD HILL (2)

Maynard Hill (in red shirt) hangs on every word as a team member launches TransAtlantic AeroModel-5 (at left).

Big Plans for a Little TAM

Setting a record by flying a single-engine airplane across the Atlantic Ocean may seem like old news, until you learn that the aircraft in this case weighed about the same as a sack of potatoes and carried less than a gallon of fuel. Last August, *The Spirit of Butts' Farm*, the first model airplane to fly across the Atlantic, rang up two other world records for model aircraft: a distance of 1,883 miles and a duration of nearly 39 hours. (Insitu Group's aerosonde, which crossed the Atlantic in August 1998 with a pre-programmed autopilot, was in the robotic aircraft class rather than the model class. See "Breaking the Sonde Barrier," Oct./Nov. 1999.)

"For three hours we didn't hear anything," Hill says. "We called the guys driving from Dublin to the coast to tell them to turn around and go home."

The aircraft's builder, Maynard L. Hill of Silver Spring, Maryland, began thinking about such a quest in 1996, when he realized it might be possible to keep a model in the air (at a modest speed) long enough to cross the ocean at one of its narrowest spans: Canada to Ireland. He assembled a team of fellow modelers in 1998 and began flight-testing his designs the following year at his friend Beecher Butts' farm.

Over four years, Hill developed an airframe that he designated the TransAtlantic AeroModel (TAM). It was just over six feet long, had a six-foot wingspan, and weighed about 11 pounds fully fueled. In August 2002, he tried three times to fly a TAM across the ocean, launching from Cape Spear, Newfoundland. Each attempt failed. Last year, driven by his freely confessed "addiction to balsa wood and glue," Hill returned, with spare TAMs. By now he had fine-tuned the aircraft. "I paid the drag penalty of a slightly fatter fuselage to put all the fuel in a single tank," he says. "I shifted the wing position forward to accommodate a center-of-gravity shift as fuel was consumed. I also moved the autopilot to midway between the wing trailing edge and the stabilizer leading edge so rainwater couldn't be sucked in to foul the electronics."

The autopilot was designed to work with the Global Positioning System to navigate essentially a great-circle route from Cape Spear, the easternmost point of land in North America, to Mannin Beach, on Ireland's west coast. An onboard transmitter sent GPS-computed location data to ARGOS satellites, which relayed the information to a ground station for conversion into e-mails so Hill and his associates could track the TAM on the Internet. The idea was to manually launch the model and maneuver it to a cruising altitude of 1,000 feet, then trim it for straight-and-level flight before activating the autopilot. At the other end, team members would be waiting to take control of the model as soon as they spotted it. The rules for setting a record require that a model land within 1,640 feet of a designated spot.

On August 8, 2003, Hill's team launched TAM-4, only to lose contact seven hours later. The next day, Hill tried again with a fifth model. Over the next 48 hours, he and his team received some 450 e-mails indicating that TAM-5 was steadily progressing across the ocean. The only moment of panic came 28 hours into the flight, when telemetry stopped. "For three hours we didn't hear anything," Hill says. "We even called up the guys driving from Dublin to the coast to tell them to turn around and go home." Fortunately, the crew disobeyed—the aircraft suddenly reappeared on the tracking system.

On the afternoon of August 11, TAM-5 flew into view and was recaptured via radio control by onsite pilot David Brown, president of the Academy of Model Aeronautics. Brown brought the model to a landing only 35 feet from a substitute touchdown point (the designated spot turned out to be too rocky). Less than two ounces of fuel remained in the 80-ounce tank. *The Spirit of Butts' Farm*, averaging 48 mph, had consumed about two ounces of fuel per hour for 39 hours.

Brown's wife, Sally, quickly got on the cell phone to alert the team in Newfoundland. "We raised a whooping cheer," Hill says, "then I buried my head on my wife Gay's shoulder and wept unashamedly for joy."

—Stuart Nixon

Moments & Milestones is produced in association with the National Aeronautic Association. Visit the NAA Web site at www.naa-usa.org *or call (703) 527-0226.*